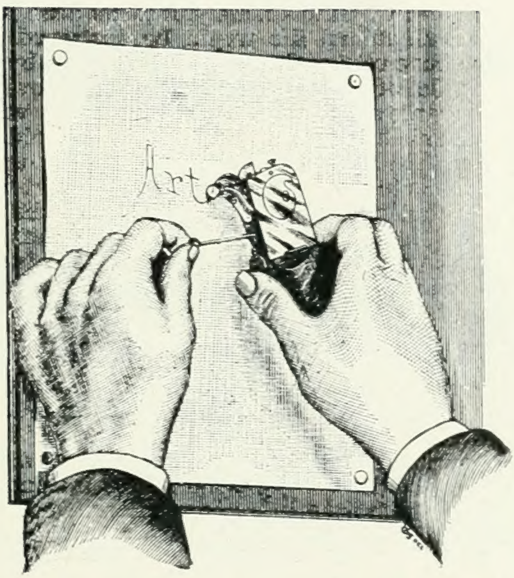
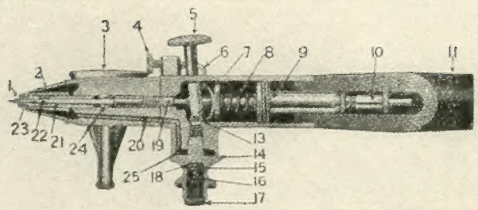


Figure 1
The Walkup Air Brush in Use

2



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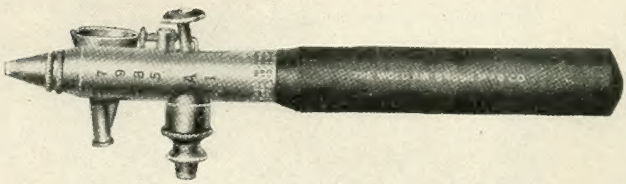

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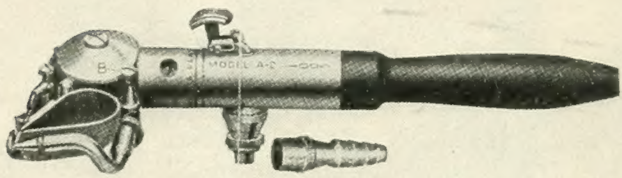

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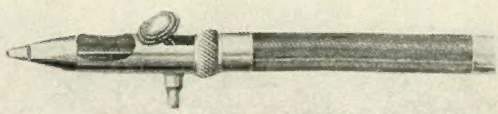

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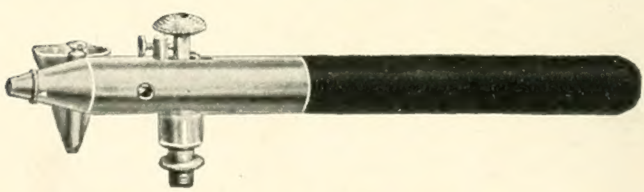

1. The Walkup Air Brush (overleaf).
2. Cross-Cut of Wold Air Brush, "A-1."
3. The Wold Air Brush, "A-1."
4. The Paasche Air Brush, "A."
5. The Aerograph, "A."
6. The Thayer and Chandler Fountain Air Brush.

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The Air Brush and the Photographer

Since time immemorial various devices have been employed by artists and craftsmen in applying colors to a surface. The commonest of these is the implement known as a brush. The artist's brush, a tuft of flexible material such as hair or vegetable fiber attached to a stock or handle, runs back to a venerable antiquity. It was sung by Homer, *circa* 1000 B. C. and is still widely used, unchanged in form and substance since that remote time. Three thousand years after Homer, however, and in our own day, Liberty Walkup, an American, introduced a daring innovation to which he gave the name Air Brush, *circa* 1886 A. D. His description of his invention, as "an art tool, designed to replace the artist's brush for the rapid and uniform distribution of color on any kind of surface by an atomizing jet of air," cannot be improved. In form and shape Walkup's air brush was, and is, unlike anything ever seen upon the earth. But in use it was, and is, satisfying and efficient for its purpose, fulfilling all its inventor's claims. On another page I reproduce the only available illustration of the Walkup brush in use, Fig. 1. The air brush of today, more presentable and more convenient in the hand, closely resembles the familiar stylographic pen, with the addition of a length of rubber tubing for the supply of the air pressure by which the color is distributed.

A Finishing Tool. The usefulness of the air brush to the photographer chiefly concerns the after-treatment of negatives and prints. By the term after-treatment here is meant any manipulation of or hand work on the negative intended to change, modify or improve its quality for printing or enlarging purposes; or any method of modifying, "working-up" or finishing prints in monochrome or colors. Primarily, then, the air brush is a finishing tool and belongs to the retouching or finishing department of the professional, specialist and commercial studio. As such it has a vital interest for photographers, an interest not yet sufficiently recognized or appreciated. It is the purpose of this little book to develop a larger interest in the air brush, and to help photographers to a better appreciation of its many-sided usefulness in photography.

Other Uses. Apart from its usefulness as a finishing tool, the unique facility of the air brush in the application of colors, sizes, varnishes, lacquers, sensitizing solutions and the like to any kind of surface, invests it with interesting possibilities for other kinds of work. It is said that those who use the air brush find a new use for it every day. I don't doubt it. For laying delicate tints on mounts, stencil designing and mat making for display mounts, folders or commercial and sample albums; blending several portraits or commercial photographs of articles printed or mounted as combinations; hand work in pictorial photography; isolating a figure in a group in copying; sensitizing and pigment coating of papers for gum-bichromate printing, and the sizing and sensitizing of thin tissues or extra thick papers for special printing papers, with many similar uses, the air brush undeniably offers many advantages over the old, familiar hand methods.

Further Afield. Outside of purely photographic lines, the air brush is widely used by photo-engravers as a retouching tool in preparing originals for reproduction. Thus the exquisitely finished photographs of machines, furniture, automobiles and jewelry seen in the catalogues of the manufacturers of these products represent, alas! not so much the perfection of photographic methods as the super-excellence of air-brush

work. Lithographers use the air-brush as an indispensable aid in designing and working on the stone or plate; newspaper illustration departments, where the meanest apology for a photograph must be transformed "in a jiffy" into an attractive picture of some famous person or place, could hardly exist save by the grace of Walkup's wonderful invention. And so in a hundred crafts, wherever brush or pencil work, tinting or coloring are used: in drafting, designing, shading, stencil or decorative work on metals, fabrics and pottery, tinting laces, feathers, fans or wooden articles, in the illustration of advertisements, poster and sign making, cartographic and survey work, etc., the air brush finds an ever-increasing usefulness. Similarly, in Brobdingnagian scale as a "sprayer," the air brush does yeoman service in the industries, where it is generally employed for applying paints, bronzes, lacquers and varnishes in the "finishing" of surfaces, from the interior casing of a Vest Pocket Kodak to the walls and ceilings of the largest of manufacturing plants. Here, however, we wander from the air brush as an art tool. In these pages we must confine ourselves to its usefulness to the photographer.

Conservatism. We photographers, forever aping the "artist," are ultra-conservative, yielding up our conventions and traditions only in the face of persuasive and persistent advertising. The air brush has not yet been advertised in this way to photographers. As a consequence it is better known and more widely appreciated by commercial art workers outside photography, than by the photographer for whom it was invented. For which reason I write it large, here in the beginning, that for every purpose where the use of a brush offers advantage in photography, the air brush as far surpasses the classic brush of the painter as the electric motor surpasses the ancient man and horse power which it has displaced.

An Interpolation. Even the artist does not confine himself to a brush. It is told of some that the hand was directly applied to the canvas to produce the desired effect. There was one, indeed, who boasted that a brush could not be found in his studio. Doubtless he

used his palette knife, as well as hand and fingers, in applying his pigments. Why not? As we all know, in some methods of coloring photographs and working on the back of a negative, the finger tip, with or without a piece of soft rag, will do work that no other instrumentality can do so well. Similarly, in other methods, we use powder, pastel and crayon, or color the film behind glass, in the effort to get softness and "blend" in place of the hard and fast touch of the old-style brush. It is in this, the delicate application and precise distribution of color, that the air brush is the *dernier cri.* It will give the finest line and softest detail of which the crayon is capable. In area work, the laying on of washes and infinitely graduated tints, the air brush is unapproachable in facility and result. More than this, the air brush responds with a better grace to less skillful hands, and does its work with an incredible saving of time.

Not a Machine. The quality of the results obtained with the air brush depends most largely on the mental attitude or viewpoint of the worker, apart, of course, from the mere manual skill applied in its use. It is not a machine, but a hand tool. Too often the air brush is spoken of as a mechanical tool, even by those who should know better. I protest the phrase. It is true that in the hands of a mechanic without feeling or taste, the air brush produces work chiefly remarkable for its mechanical perfection. The average air brush catalogue, with its terrifying display of parts and equipments, emphasizes this mistaken notion. These accessories, however, are merely instrumentalities for supplying and controlling the air pressure which gives the air brush its characteristic facility in color distribution. As a matter of fact, the air brush is as truly an art or hand tool as the painter's brush, capable of as large a variety of effects, as responsive to and revealing as fully whatever measure of individuality its user may possess. It is the man behind the brush that tells, just as it is in the case of the artist's brush. The art in the result must come from the man whose hand wields the brush.

The Art of It. Note well the significance of that

last sentence. The rare qualities and effects we admire in the masterpiece of painting or in the cleverly handled water color sketch are produced, not by the brush of the artist, but out of the years of training and acquired skill he puts into his use of the brush. So with the air brush. It offers an undreamt-of facility in obtaining desirable effects by the application of color to a surface. Rightly handled, it will give these desirable effects more rapidly with, perhaps, less skill than the old-style brush demands. But it is only a brush at best, and the quality of the result varies, as with any other sort of brush or tool, according to the knowledge and skill of the individual worker in its use. I cannot put it plainer. Possessing an air brush, and knowing how to use it in a mechanically efficient way, will not give the reader any special skill in drawing, art anatomy, composition, the balance of light and shade, the use of color or any of the other essentials of artcraft as applied in photography. It follows that the photographer who seeks to get the most out of his air brush must bring that trained knowledge of the methods of art which the painter brings to his use of the brush, together with a special, technical skill in the methods used in retouching and "finishing" negatives and prints. As to this, however, there is generally at least one worker in every photographic studio possessing some sort of art training, and it is into his or her hands that the air brush should be placed. With which preliminary discussion of the air brush and its possibilities, we may now pass on to a detailed study of the brush as a tool and the methods of its use in photographic practice.

Commercial Forms. The form and make-up of the air brushes of today may be seen in the accompanying illustrations. For more complete data of equipment the reader is referred to the catalogues of the makers. In all these lists will be found a bewildering variety of air brushes and equipments of different designs, with many of which the photographer need not concern himself, as intended for other than photographic uses. The essential features of the air brush equipment are the hand piece or brush proper, a container for the supply of compressed air and some means of regulat-

ing its pressure, with the rubber tubing connecting the two.

The Principle. Differing in minor details of design, interior construction and operation, all air brushes are alike in principle. They project liquid pigment in the form of fine spray produced by the aid of compressed air. We can broadly visualize this as a combination of the stylographic pen and the atomizer. In the stylographic pen the ink is carried in a reservoir within the handle, being drawn along the needle or wire which forms the writing point by the force known as capillary attraction. You touch the pen to paper, the ink flows and you write, the fineness or thickness of the letters being controlled by the annular space or "feed" at the point through which the needle just protrudes. In the atomizer the liquid is projected, as a fine spray, through a tiny nozzle, being atomized near the point of emergence by a stream of air produced by hand pressure on an air-filled rubber bulb connected with the bottle or container holding the liquid.

How the Air Brush Works. Let us look at the interior details of an air brush and see how it works. In Fig. 2 we have a cross-cut of the Wold Air Brush "A-1" which, as sold, is seen in Fig. 3. It has a hollow cylindrical handle (11) closed at the rear end, having at the other end an open nozzle or "color tip" (1), in shape a truncated cone. There is an inner, conical nozzle concentric with the color tip, and so placed as to have an annular space outside of it forming the "projecting air tubes" (23). Within these tubes we see a long, accurately pointed needle (22) which has a back and forth movement from the color tip, with a guide (7) and spring tension (8), with bearings (9) and a "chucking cap" (10) for the exact adjustment and alignment essential to its proper movement. The pointed end of the needle enters the inner end nozzle (23), closing it when moved forward and opening it when drawn back—thus controlling the flow and amount of color projected from the tip. The movement of the needle itself is controlled by a double-action finger piece (5) called the "air and color distributing lever," which is operated by the pressure of the first finger (or thumb,

according to the design of the brush). Immediately in front of the distributing lever is the "line adjustment screw" (4) which, by controlling the forward movement of the needle, adjusts or "sets" the width of the spray or line and regulates the flow of color to the tip. The color is held in a small cup (3) attached to a side nozzle connected with the "color inlet" (24) admitting the color to the needle valve; or it may be carried in a reservoir within the forepart of the brush as in the Aerograph "A," a British brush (Fig. 5); or in a spoon or pan close to the tip, as in the Paasche brush "A" (Fig. 4) and in the original Walkup brush (Fig. 1). Referring again to Fig. 2, a third nozzle is provided (17) to receive the rubber tube or hose connected with the compressed air supply. When the air is turned on it passes through this nozzle into an air chamber (25) from which it is released by a downward pressure of the distributing lever (5), passing into an air duct (20) to a junction with the color inlet (24), there reducing the liquid pigment to an infinitely fine spray which travels along the needle and issues from the end nozzle or tip (1) with high velocity.

In Operation a downward pressure of the first finger tip on the lever release (5) opens the air valve and admits a stream of air. A downward and slightly backward pressure of the lever (controlled by the line adjustment screw and the spring tension) draws the needle back from the inner tip, thus opening the color valve constituted by the inner end nozzle and the needle. By this double-action movement of the distributing lever the stream of air passes from the air chamber (25) to the air cap (2) forming a suction at the color inlet (24) and drawing the color around the needle into the color tip head (21), from which it is projected or blown out as fine spray in the form of a cone, with its base on the surface being worked on (as a print) and its apex at the nozzle or point of the color tip.

Other Air Brushes differ somewhat in their construction and operation from that just described. For these differences the reader is referred to the instruction book accompanying every brush, which explains its mechanism and use. This instruction book should be care-

fully studied, brush in hand, before any work is attempted. Among the Wold brushes, Models "A-1" and "U" are designed for the photographer's use. In the latter the form of the distributing lever is changed so that a single downward pressure controls both air and color, the line adjustment screw being placed behind the lever. Of the Paasche brushes, Models "A" and "B" are advised for photographic uses. In these models the color cup (pan) is so placed and adjusted that the color is not taken into the shell or body of the brush—a desirable feature which obviates any tendency to clogging of the brush on this score. The Paasche Model "C" has a thumb-action lever release, "for use by artists with unsteady hands" says the obviously ante-prohibition catalogue. The Aerograph, designed by an American, Charles L. Burdick, is made and marketed in England, not being available in this country. Its novel arrangement of the color receptacle in the fore body of the brush, and the knurled band behind the distributing lever which acts as the line adjustment screw, are points of difference worth noting. The Fountain Air Brush of Thayer and Chandler, seen in Fig. 6, is an old favorite among photographers, being the first modification of the Walkup brush. Whether Walkup's brush is still in the market or not I do not know, no response coming to my request for information.

The Choice of an Air Brush. The advantages of the different designs and models available are fully set forth in the makers' catalogues. I can offer no advice as to a choice among them. They are all good and completely equipped for their purpose, so that choice must be a matter of personal preference. At the easel of a professional worker one will usually find several different makers' brushes on the hangers or rests, adjusted and used according to the worker's preference in different classes of work. The reader will do well, before purchasing an air brush, to consult with an experienced air brush operator and, if possible, to see several air brushes in use.

Manipulation. The air brush, in use, is held as one holds a pen, at a right angle to the work on the easel,

and with the first finger crooked instead of lying flat, so that the tip of the finger rests squarely on the lever release. Supposing the color cup to be attached and the air turned on, the width or fineness of the color spray, regulated by the line adjustment screw, is governed by the backward movement of the distributing lever and by the distance away from the work at which the brush is held. For example, fixing the line adjustment screw for a line, a quick stroke of the brush across a sheet of paper, with the distributing lever pressed downward and forward against the line adjustment screw, and the brush held at half an inch from the paper, will give a fine (narrow) line of color. If now the brush is held at a distance of five to ten inches away from the paper, and the lever is pressed downward and slightly backward, the width of the spray will vary according to the distance, the adjustment of the line screw and the backward movement of the lever. The result in this instance will be a wash or area deposit of color instead of a narrow line. It is thus seen that the crucial point in air brush work lies in the mastery of this twofold movement of the distributing lever and the setting of the line adjustment screw. This can come only from practice. It is largely a matter of feeling or touch, as in piano or violin playing, and must be cultivated by the same assiduous practice. As skill comes, the pressure or movement of the distributing lever is varied unconsciously with the variation of the working distance, just as the retoucher changes the form and density of his pencil touch, from moment to moment, as needed by the work in hand. Thus the flow of color from the tip of the brush may be regulated so as to give a fine, vigorous line or an infinitely soft wash of thin, transparent color, the brush being held at different distances away, and the touch or pressure of the finger on the lever being different in each case. When applied as a thin wash or tint, the color deposit dries almost instantly (if working on glass, this should be slightly warmed), so that repeated washes can be superimposed, one over another, without fear of any injurious effect on previous coatings, until the desired depth or intensity of color is obtained.

Service Conditions. It is seen that the air brush is an instrument of fine workmanship and delicate adjustment. It follows that, like a watch, it must be kept scrupulously clean, with all its parts in perfect adjustment and alignment, if it is to give good service. Nothing more than reasonable care, however, is required. The parts most subject to wear and tear are generally made of platinum or non-corrosive metal, so that, barring accident and carelessness, repairs will rarely be needed. The needle is easily bent by careless handling. This will disturb the alignment and so affect the discharge of color. The chief trouble to be expected is the clogging of the delicate air and color ducts, color inlet and tip, with dried color, grit or other obstructions. All colors, except aniline dyes, contain a proportion of gum, and if left in the brush after use, will give trouble. The brush, of course, should always be cleansed after use. This is very simply accomplished by blowing water through it to remove any color remaining in the passages or tip. An occasional, supplementary blow with wood alcohol is well worth while. The re-adjustment and re-alignment of parts are the only critical repairs likely to be needed. For these it is advisable to send the brush to its maker, although the books give detailed instruction on these points. It is especially advised that the air brush should not be loaned or put into hands not familiar with its use. But the traditional jealousy of the artist as to lending his brushes will suffice as to this point.

The Air Supply. We now come to the accessories, chief among which is the indispensable air supply. This may be provided in several ways: by a small hand or foot operated pump connected with a small tank or container; an electric motor driven pump; or the use of liquified carbonic acid gas. The choice among these must be determined by the reader's need. Working details and the advantages of the different systems are explained in the manufacturers' catalogues and need not be repeated here. The essential thing is a regular and constant supply of compressed air to the brush—regular in flow and constant in pressure. For photographic purposes a pressure of from 20 to 30

pounds is generally advised, but this will vary according to the brush in use, the class of work in hand and the skill of the worker.

Hand and Foot Pumps. With these the air is pumped into the tank or container which forms part of the apparatus until a sufficient pressure is obtained, as indicated by a gauge attached to the tank. When once filled, a few strokes of the pump given by the operator from time to time will suffice to keep the air in the tank up to the required pressure. Where the air brush is not in constant use, or for use with a single brush, these hand or foot pumps are simple in operation, not expensive and quite efficient. For many years no other type was available. They have the disadvantage of possible irregularity in supply and variation in pressure, and when in constant use are said to set up a slight nervousness in the operator which has its effect on the quality of his work.

Motor Driven Pumps are more convenient in use and perfect in efficiency, being much used in commercial establishments where several brushes are kept in operation. They include an air compressor driven by a small electric motor with an automatic switch and pressure gauge, all compacted in one unit. In operation the motor driven pump is inexpensive and it can be operated on any electric light or power circuit, providing a steady and uniform air supply.

Gas Apparatus. Simplest of all methods of air supply, however, is the use of liquid carbonic gas. This can be obtained from any soda water or saloon supply house, in steel drums or cylinders of 20, 40 or 50 pounds, easily replaceable as needed and inexpensive in use. As so obtained the cylinder needs to be fitted with a reducing valve and pressure gauge for the regulation and control of the gas pressure in use. There need be no fear of danger in the use of these gas-filled cylinders if they are stored away from the direct rays of the sun, nearness to a fire or other source of heat. This system of air supply is cleanly and convenient, always ready for instant use, and the best available where electric or foot power are not obtainable or desirable.

Other Methods. Of the use of a water pump for

compressing the air, or of the belt-driven pump connected with a line of factory shafting, nothing will be said here. They are wholly practical in application, but hardly adaptable for use in the average photographic workroom or studio.

Easel. A sturdily built easel, readily adjustable and rigid when adjusted, is a big help to good work. The architectural designer's drawing table is most commonly employed, with a swinging arm at one side, carrying the color rack, brush rests and other tools. The color rack is a small, metal box designed to carry 8 or 12 two-ounce bottles containing a supply of as many different colors, each bottle fitted with a dust-proof screw top carrying a glass tube filler for taking supplies of color to the color cup on the brush as needed. The easel should be adjustable for a standing and sitting position, and should be placed so that an abundance of light, preferably from the north, falls on the work in hand at an angle of 45 degrees from above the operator's right shoulder. In addition to the supply of colors, the color rack should carry a small (¼inch) bristle brush for cleaning the color cup; carbon pencils H, HH, and HB; an etching knife; drawing pins; some powdered pumice; a bottle of ammonia water; rubber cement; a supply of frisket or mask paper; two or three small water-color brushes for pointing fine details, and a piece of pointed rubber eraser of good quality.

Colors. Common sense here means the use of the very best colors obtainable. It is essential that the colors used for air brush work be dustless, absolutely gritless, smooth-working and as permanent as may be. Cheap colors are apt to be troublesome in preparation and poor economy in use, change on exposure to light and air and so throw discredit on the work done with them. The quantity of color used for any single piece of photographic work is so small that color expense is not worth consideration. If you, later, come to the coloring of bromide enlargements for theatrical and advertising posters, measured by the square foot and generally short-lived in use, then you can begin to "count the pennies" in buying your air-brush colors.

Buy. Don't Make Them. It is possible to prepare

your own colors; but this means the most careful grinding, straining and what not to ensure smoothness and freedom from grit. There are many brands of air-brush colors in the market, reliable and ready for use, and the reader will do well to buy and use these rather than to attempt to make his own. Whether purchased in tubes (moist), bottles (liquid) or in powdered form, it will generally be desirable to mix working solutions of two or three different strengths for use by simple dilution; also by admixture to obtain special colors or shades. This applies especially to "black" and "sepia," where the liquid pigment must match the color or tone of the print to be "finished." A "neutral tint" is also much used. This may be obtained by mixing black and blue, or better, violet and gamboge. For working on negatives, i. e. in strengthening a weak portion, dyes or transparent colors are used; if for blocking out, then opaques.

Black. For preliminary practice work a good lampblack (not waterproof) is advised, as with this the color can be removed, in case of mistake, by simply immersing the print in water and using a tuft of cotton. For work which is to be delivered, of course, permanent or waterproof color is used. In the use of lampblack the tone can be modified by the addition of water. Sometimes an admixture with Payne's gray will offer advantage. A cold black is obtained by admixture with a little indigo-blue, and a warm black by the addition of a small quantity of brick red. For a rich, deep black for reproduction prints, first work the print with a normal black, then superimpose a thin wash of sepia over the black.

Sepia. A good commercial sepia is readily obtainable, but the tones of "sepia prints" vary so widely and are sometimes so uneven in color even in the same print, that you may need a warm sepia, Vandyke brown, bister and brick-red in addition to the commercial sepia.

Color Lists. Theoretically, the many different colors or tints needed in air brush work may be obtained, if one uses true and pure colors, by mixture and combination of the primaries red, blue and yellow. But in

practice this means a knowledge of the harmony of colors and does not always result in clear colors for use. Those seeking such a knowledge are referred to such handbooks as Hatt's or Sanford's Manuals. The following lists give a variety of the colors most used, which the air-brush worker can keep on hand.

List 1. Alizarin-scarlet, rose-madder, Antwerp blue, French ultramarine, Prussian blue, burnt sienna, raw sienna, bister, Vandyke brown, aureolin. These are transparent and permanent.

List 2. Vermilion, ultramarine blue, Hooker's green (light), chrome lemon, raw sienna, burnt sienna, mauve (reddish), crimson lake, sky blue, Hooker's green (dark), chrome orange, raw umber, venetian red and mauve (bluish).

A good "white," such as blanc d'argent or reproduction white is indispensable. These are opaque and free from lead, hence they do not change under light action.

Working with Colors. The general rule in the use of colors on a photographic base is to under, rather than over color, i. e. to avoid garishness by suggesting rather than by applying a heavy wash of vivid color. The air-brush expert does much of this sort of coloring by superimposing one tint over another to get the color effect desired. To strengthen shadows apply neutral tint; to make the tone colder, apply blue; if the tone is too cold or gray, spray on a little crimson or yellow as may be needed. Sometimes a spray of gum-water is all that a shadow needs to warm and lighten it in tone.

Progressive Lessons. We can now profitably take up the practical use of the air brush. This should begin with a series of progressive practice lessons, covering the proper holding and operation of the brush and the method of applying or distributing color. When these have been mastered, the reader may begin the working-up or finishing of large prints in black and white or sepia, thence going on to coloring or working with colors. It is advisable to learn how to use the air brush on paper prints or photographs before attempting to work on negatives, the glass or gelatine surfaces of which require more skill in handling.

Holding and Operation. Fix a sheet of practice paper on the easel board and place the easel in a good light and position favorable to comfort in working. Any cheap, matt-surfaced white paper free from spots or lumps will serve. See to the air supply and adjust the pressure to 20 or 25 pounds. If the rubber hose connecting air supply tank and brush is new, it may hold some particles of dust, grit or powder, so that it will be well (before connecting it with the nozzle on the brush, to blow out the air line so as to clear it of dust or grit by turning on the air from the tank. Now connect the air line with the brush and give this a blow through to make sure that the delicate passages of the brush harbor no dust or grit. Half fill a color cup with lampblack and attach it to the brush by gently connecting it with the opening at the side of the brush, and place the brush on the easel rest ready for use. Set the line adjustment screw for a line, i. e., so that the shaft of the distributing lever rests against the nut or tip through which the line adjustment screw passes.

The First Lesson. Sit comfortably at the easel so that the right hand and arm can move freely in any direction over the practice sheet. Take the brush in hand, hold it as you hold a pen, with the first finger tip well forward over the distributing lever, and at a right angle to the sheet. Turn on the air. We are going to practice the making of horizontal lines across the practice sheet, about an inch apart with an inch margin at each end. The object in view is to make a clearly defined line of even width and even in color or tone. Bring the brush into position with the tip over the left-hand edge and near the top of the sheet, at a distance away of about half an inch from the surface of the sheet. Now start the stroke as if to move in a straight line from left to right across the sheet. While the brush is in motion and when the tip reaches the point set for the beginning of the line, press the distributing lever downward and forward (i. e. against the line adjustment screw), and keep the brush in steady movement across the paper at the half-inch distance. When within an inch of the right hand edge of the sheet, with the brush still in motion, release the pressure on the

lever, thus stopping the flow of color and ending the line or stroke. The trick heie is to learn to keep the brush in motion without pause or hesitation, and to start and stop the flow of color while the brush is in motion. To start the brush in motion and the flow of color simultaneously or to stop them simultaneously means a blot of color. Learn, also, to start and stop the flow of color in a gentle and continuous motion or pressure and release of the distributing lever, not with a jerky or spasmodic movement. If you watch an air-brush expert at work, his brush is seen to be in perpetual motion, restlessly moving with a free, easy waving movement and continual variation of the distance, over the face of the work on his easel. The pressure of his finger on the distributing lever and flow of color from the top of the brush are, however, by no means continuous, but are stopped and started from moment to moment as he needs to distribute color at this or that part of his work.

This practice lesson in making horizontal lines, even in width and uniform in color, without spot or blot marking the beginning or end, should be kept up until fair proficiency has been obtained. Its purpose is to teach the student how to control the double action of the distributing lever; how to start the air and color flow with a gentle, continuous pressure after the brush is in movement and to release the finger pressure before the end of the stroke; how the width or fineness of the line is controlled by the line adjustment screw and the distance between tip of brush and practice sheet.

Second Lesson. When the making of a good, clean horizontal line has been mastered, the reader should proceed to the making of vertical lines from the top to the bottom of the sheet; then of short lines at various angles resembling the angular strokes of the penmanship copybook of childhood; then of small and large curves, dots placed at fairly regular intervals, circles, ovals, the double or return curve and so on. In this way only are the hand and finger trained to control the movement of the brush and finger piece, to begin and end the stroke without blot, so that the lines are lighter, rather than darker, at the beginning and end. In this

practice work the attempt should be made to completely finish or cover the practice sheet with the brush in unceasing motion, and the starting and stopping of the color flow under control at all times.

Third Lesson. The distribution of color within an area may next be attempted. Here the object is to learn how to apply color in an even or graduated tint within a given area or space. At first, one may outline with a pencil variously shaped spaces on the practice sheet, and try to fill them as evenly as possible with a tint or deposit of color, working with the brush at a distance of ten inches from the sheet. Set the line adjustment screw for a line, control the color flow by the finger pressure on the lever, the first downward pressure opening the air valve and so starting the air, the further downward and slightly backward pressure opening the color valve and starting the flow of color, which latter is in part regulated by the setting of the line adjustment screw and the spring tension behind the needle.

The depth of the tint is governed not only by the distance between brush and sheet, but also by the speed of the stroke. In this lesson learn to maintain an even distance between the tip of the brush and the sheet, and to keep the brush moving at a uniform speed. It is obvious that the deposit or tint will become heavier in color and coarser in texture as the distance between brush is lessened, and that the tint will be thinner and finer in texture (covering a larger area) as the distance is increased. Similarly, where the distance is maintained uniformly during the stroke, the tint will be thinner or heavier as the speed of the stroke is quickened or slowed down. Evenness or uniformity of tint is secured by uniformity in speed of stroke or movement and in working distance. As a consequence, if the stroke is started with the brush at five inches distance from the sheet and the speed of the stroke and distance are gradually increased, we will get a tint gradually increasing in width but decreasing in density of color as the end of the stroke is approached. Graduated tints, however, are usually made by first securing an even tint over the whole area, and then superimposing

successive horizontal or vertical strokes. Always remember that the brush must be in motion before the air and color flow is started. In tinting an outlined space, for example, begin the brush movement outside the outline, bring it to the proper working distance at the outline and gradually start air and color as near the line as may be, keeping up an even flow of color and uniform speed of movement throughout until near the end of the stroke, when the pressure of the finger on the distributing lever is gradually relaxed so that the tint fades out rather than ends abruptly in a rough or heavy fringe of color.

Fourth Lesson. This may cover the making of tints with even, smoothly defined outlines and of any desired form or shape, such as a rectangular panel in tint on a white ground, or a tinted circle behind the head in a sketch portrait on a white ground. This is done with a mask or form, cut out of heavy cardboard or matt celluloid. For example: cut out a mask having an opening 4 x 6 inches, with an ample margin of card on every side to protect the practice sheet. See that the edges of the cut-out are cleanly and smoothly cut. Fix this mask over the practice sheet with pushpins so that its inner edges fit closely to the sheet. Now, holding the brush at, say, 15 inches from the sheet, blow on an even tint with steady strokes across the cut-out at an angle of 45 degrees. See that each succeeding stroke slightly overlaps the one it follows. If the tint is not sufficiently heavy, begin again at the top at a working distance of, say, 10 inches from the sheet and work with a reversed angular stroke.

To produce a graduated tint from top to bottom, begin at the top of the sheet after laying an even tint, and cross and recross the opening of the cut-out, gradually decreasing the distance between brush and paper as you approach the bottom of the opening. If the graduated tint is to run from side to side, use vertical strokes up and down the opening—in all cases beginning and ending the stroke beyond the actual edges of the cut-out, i. e. on the margins of the mask.

For a circular tint, cleanly cut a circular opening of the size desired from a piece of heavy cardboard and

fix the mask on the practice sheet with pushpins. Set the brush for a line to ensure an even flow of color. Work the brush at 10 inches from the sheet, with a free, swinging movement, crossing and recrossing the cut-out at an angle of 45 degrees with an increasing movement of the brush, but starting and stopping the color flow as the stroke crosses the edges of the cut-out. To increase the depth of the tint from the circumference to the center of the circle, make strokes parallel with the outline of the circle and gradually decrease the distance between brush and sheet as you approach the center portion of the circle. A clean, evenly graduated tint here depends upon maintaining a free but steady motion of the brush, an even flow of color, and a nice regulation of the working distance.

It will be obvious that the form or shape of a tint can be infinitely varied by the use of differently shaped cut-outs or masks. Thus the pointed tints seen in the vignetted backgrounds of sketch portraits are made by the use of cardboard or celluloid forms with sharply pointed zig-zag edges of uneven outline. "Cloud-forms," also used in sketch portraits on a white ground, are usually made by roughly tearing pieces of white blotting paper to an approximate cloud shape and using these as forms. Tint panels with shaded, beveled edges, similarly used, are made by first blowing on an even tint over the panel space and then, after protecting or masking all the face of the tint except the small margins which are to form the beveled edges, blowing in a slightly heavier tint over the unprotected marginal space, darkening the corners and outlining the edge of the bevel with a sharply-pointed rubber eraser and ruler. In other instances only two sides of a rectangular panel may be shown, with a graduated tint running from the angle formed by the two sides of the panel, and so on.

Finishing Prints. Having by means of this or any similar series of practice lessons acquired a working familiarity with the air brush and the principles of its operation, so that he can produce, at will, a fine soft line or spot, a broad wash or tint, graduated or perfectly even in depth of color, within a prescribed area, the

reader may now take up the actual finishing of photographic prints. Spoiled or "waste" enlargements, if not too heavily printed, offer the best sort of practice material, and sepia-toned prints are preferable to black and white.

Preparing the Print. We are now to work on a photographic print, i. e. a print on paper sized or having a gelatinous surface, which has been more or less handled, and so may be somewhat "greasy" or repellent of liquid color. The first step, therefore, is to prepare the surface of the print so that it will "take" the color. This can be done by rubbing it over, carefully and with a light hand, with powdered pumice; or with a wad of absorbent cotton, cheese cloth or fine sponge wetted with weak ammonia solution, such as household ammonia diluted with an equal bulk of water. A mixture of equal parts of denatured alcohol and water or a weak solution of ox-gall will serve the same purpose.

Spotting. Before beginning work with the air brush, the print should be carefully spotted. Small white spots, hair lines, etc., are best removed with a finely pointed carbon (HH., H or HB) pencil, the rougher surfaced papers requiring the softer grades. Larger spots or patches are evened up with a camel's hair brush charged with color matching that part of the print worked upon. Dark spots, unsightly creases in a dress, obtrusive twigs or details in an outdoor scene and the like, are removed or softened with an etching knife; not by violently picking them out so as to leave a white spot needing spotting, but by lightly scraping them down until they match the color of the surrounding part of the print. Use a light touch in this sort of work, and see that the etching tool has a shaving edge in perfect condition, so as to avoid breaking or roughening the surface of the print. Practice makes perfect.

"Finishing" in Monochrome. Let us suppose the subject in hand to be an enlarged portrait: a sepia toned print, prepared and spotted as detailed above. The air brush is ready for use with a supply of colors suited to the color of the print on the easel. First step back from the easel and give the print a careful scrutiny. See just what work is needed for its "finishing" or

improvement, the faults in the lighting to be remedied, weak patches of tone or color to be evened up and so on. Note well the natural modeling of the features and head, which shadows can be strengthened with advantage; where harsh lighting needs to be modified and softly blended into the shadows to give pleasing projection to the features, or where details can be sharpened for the betterment of the portrait. Observe what is needed to improve the hair or draperies; the former may be somewhat wiry or formless in character, the latter may be badly creased or show hard angular lines. Note also the shortcomings of the outline or contour of the head and figure against the background. This may need firmness or softening here and there; parts of accessories, such as the back of a chair, the base line of the ground and so on may need to be subordinated. In short, size up the work to be done before you begin. Broadly speaking, the finishing of an enlarged portrait comprises: building up the tone values, rounding out the modeling, softening crudities of lighting and texture, subordinating obtrusive details, adding variety of tone and aerial or atmospheric effects in the background or space behind the figure.

The Choice of a Beginning Point is a matter of personal preference. Some workers begin with the background and next work over the figure or bust, finally finishing the head and face of the portrait. Others reverse this procedure. Personally, I prefer to begin with the deepest dark in the print, which may be a portion of the hair, a coat collar or some part of the draperies, so as to get a key for the tone relationships in the subject as a whole. In this scheme, beginning with the deepest shadow, first strengthen the shadows in direct ratio to their strength in the print. Then begin again at the top of the head and model the lights and half-tones into the deeper shadows, gradually working down and around the head and features. The natural projection of the head and features must be kept in mind. If the hair is seen to be wiry in character and harshly outlined against the ground, use the brush with a sweeping curved movement to soften the wiriness and bring it into pleasing masses as a sculptor does.

The working distance of the brush will vary, momentarily, from six to ten inches away from the work, as you pass from shadows to half-lights. Be careful not to obliterate the reflected lights which give life to the hair; often they may be accentuated with advantage, this being best done with a bluntly pointed eraser when the worked-up print is thoroughly dry.

The Face. Use a light spray in working the delicate shadows joining the hair and face. Set the line adjustment screw for a fine line and work at about ten or twelve inches away, modeling the thin shadows of the forehead, temples, the junction of the nose with the forehead, the recessed portions of the face under the eyebrows, around the wings of the nose, between the cheekbone and the ear and so on. The motion of the brush should generally conform to the shape of the feature worked on, and the distance of the brush tip from the work will vary from moment to moment according to the depth of color desired at different points. The halftones and delicate lights which run along the borders of shadows should be handled with extreme care. They have much to do with the modeling and must always be preserved. Avoid harsh edges or abrupt shadows everywhere.

The Eyes call for the most careful treatment. As the pupils are usually somewhat contracted by the strong light of the studio (whether daylight, electric or flashlight), their size may generally be very slightly increased with advantage in the portrait. The pupil, except in rare instances, will generally need darkening. Where it is enlarged, as suggested, the edge should be soft and not quite as dark as the central portion. Softness of outline helps to convey the sense of roundness. The high light, when double, should be corrected to a single angular or rectangular shape according to the direction of the lighting and, generally speaking, heightened in tone. Beware of the hard glitter, however, which gives a startling effect. The lightest portion of the iris comes directly opposite the highlight of the eye, shading away into the shadow of the upper lid. Strengthen the shadow running under the upper lid and eyelashes, and slightly emphasize the delicate shadows at either

end of the lid to give it desirable roundness. The corner of the eye near the nose will usually need modeling to bring back its natural form. This corner is lower and shows a small gland which catches the light, this extending along the top of the lower eyelid. Do not obliterate the tiny shadow beneath the edge of the lower eyelid under the eyeball.

The Lower Part of the Face. In treating the nose, mouth, chin and neck the shadows and reflected lights are of chief importance. There is a continual variation of surface in this part of the head, and likeness is largely dependent on the shape and intensity of the modeling of these features. It is better to do too little than to overdo, the natural form being easily lost in the attempt to smooth and finish. The shadow under the tip of the nose, around the nose wings, at the ends of the mouth, under the lower lip and beneath the chin, as well as the play of light along the upper lip and the illumination of the lower lip, call for skillful handling.

The "Finished" Print. It is not to be expected that the first few portraits finished in monochrome with the air brush, as here described, will be wholly satisfactory or approach the standard of quality required in work to be delivered. Without a doubt the beginner will see the need of going back to his progressive lessons and practice sheets to get a surer skill in the handling of the brush, and to making "studies" of the head, eyes, ears, mouth and other features of the face to get a better understanding of drawing and modeling in portraiture. But his first attempts, however poor, will prove conclusively that the air brush will give him desirable results more easily (with less laborious effort) than the old-style hand-brush method of finishing, and so encourage him to go on. Skill will come by practice.

Gum Water. Perhaps the most unsatisfactory detail in the beginner's work will be an uneven, mottled appearance in the surface finish of his portraits. This can easily be removed, and the print "pulled together" and improved, by spraying the print with thin gum water, i. e. a solution of gum arabic of the consistency of thin milk. After this has thoroughly dried and hardened, spray the whole of the print lightly with

water. This is the method generally adopted by air brush 'finishers'' and is especially desirable when prints are to be copied or reproduced.

"Finishing" Prints in Color. Much of what has been said of finishing prints in monochrome applies to the finishing or working-up of prints in color. The big difference lies in the fact that we are working with colors, and the prime essential is a good, general knowledge of color and coloring, such as is required in water color painting or working with colored crayons. This, however, lies beyond the scope of our adventure here, and I will content myself with a few hints on the practice peculiar to the use of colors with the air brush.

For prints to be colored a light, sepia-toned print is generally preferred as having a desirable warmth of color in the shadows and darker tones. But if the portrait is done in a high key, i. e. in two or three of the higher tones of white and gray, then a light "black and white" development, bromide or platinum print will serve the purpose. Skillful air-brush colorists demand a much under-printed portrait as the most suitable base, but the beginner should chose a print soft in contrasts but fully detailed in its modeling, as calling for less work and skill in finishing. Prints for air-brush finishing should be flat mounted with paste or starch; a dry-mounted print will sometimes loosen and "cockle" under the repeated applications of a liquid spray.

The Cardinal Rule in Coloring, as indeed in monochrome finishing, is to avoid overdoing; to suggest color rather than to put it on too thickly. Too little color is much better than too much. Use thin, transparent washes and repeat strokes, getting depth of color and shading by superposing one wash of color over another, working as far away from the print as is consistent with the area worked on. Do not attempt to put all the color needed in any part in one stroke or wash.

Groups of the most desirable colors for air-brush work have already been given. Learn from the beginning to work with as few colors as possible, making your combinations and shades by superposing one color over another on the print. The study of a manual on color

mixing and color harmony, such as the handbooks of Prang, Sanford and Hatt will prove very helpful at this stage.

The Vital Point is to maintain the natural relief and projection of the subject, so that the portrait will present a living person rather than a mask of colors. In this endeavor the differences of hue or color contrasts at different parts of the subject offer difficulties not encountered in handling the simpler luminosity contrasts of monochrome work. A cultivated color sense is needed. but in addition to this the worker must cultivate a sense for values, as success in this sort of work depends very largely on keeping the values and planes of the head and features in correct relationship—as they are usually found in a portrait made with a lens of ample focal length. In this a broad treatment of the portrait as a whole, by which is meant the avoidance of "niggling" or working overmuch on individual parts, is the best line to follow. Work well back from the easel; observe the relationship of the planes and values of the parts making up the whole; visualize the finished result as you work, looking at the print with half closed eyes from time to time, so as to see it in masses and planes rather than in detail.

Roughing-in. The first step, knowing the dominant color of the subject (i. e. a child with yellow hair and blue dress, a lady in fancy costume, or an old man or woman in black, with white hair), is to loosely rough-in the background, the hair and any strongly colored parts of the dress, with washes of strong ground color. No attempt is made at this stage to finish the background or any part, but simply to get the key for the general coloring, and to lay in a ground behind the head or figure which will give the effect of viewing it against the vaguely illuminated corner of a room. This will help materially in keeping the natural relief and projection of the head and figure. The choice of colors for the background will vary according to the subject and its general coloration. Brown or brownish-green with touches of dull red near the figure, bluish-purple or lavender-grey with faint touches of pinkish-grey are suggestive. In this roughing-in remember that blues

and greys give the effect of distance and are cold colors, so that the planes recede, while the warm colors by their greater luminosity cause the planes to approach. Strive for variety of tones or planes of color in the background, with more depth of tone near the draperies or contour of the figure and on the illuminated side of the head, opposing the lights and darks in the subject by this variation of tone. Sometimes the contrasting of a highly colored complexion by a luminous color of different hue behind the head will produce a desirable effect. Evenness of tone and "tightness" resulting from a too smooth finishing of the background should be avoided as making for monotony and robbing the delicate colorings of the features of their charm.

The Face. Having roughed-in the portrait generally, as described, the face (and hands, if these are shown) are given a wash of flesh tint or light yellow red. The color used will vary with the complexion of the subject, and the print in hand—whether very light or dark in tone. Care must be exercised to avoid too heavy a deposit of color on the highlights. A thin wash of vermilion may be used with dark, ruddy complexions, and with old people the use of Venetian red, tempered with vermilion, is sometimes advisable. Now remove the flesh color from the color cup, cleanse the brush with water and take a small quantity of Alizarin scarlet or Indian red. In some instances the latter may be modified with burnt umber with advantage. This is now carefully applied in the deeper shades of the face, tinting the cheeks lightly, giving color to the lips, the shadow under the lower lip, chin, the wings of the nostrils, the lobes of the ears. the shadow under the lower eyelids and so on. In portraits of children the coloring of the cheeks may be a combination of Alizarin red and vermilion, keeping the vermilion and a touch of yellow near the highlights on the cheek bones and rounded tip of chin and nose, as well as the lower lip, and a touch of bright scarlet at the inner corners of the eyes, etc. Again cleanse the brush and take Prussian blue. A very light application of this is given to soften the joining of the hair and face, around the outline of the cheeks and neck and over the half-lights—under

the eyebrows, at the temples, on the lower lip and under the chin, blending the lights and deeper shadows with a pearly-grey. In the case of brunettes a few touches of blue, purple or green will enliven the half-lights of the hair, but the shadows should be lightened with yellow and generally kept warm in color. With this class of subject green is a useful color. While the brush is charged with blue or green, apply these to the background or draperies where advantage may so be gained. Thus blue over a brownish-green ground around the upper half of the head will generally heighten the atmospheric effect in the ground of the portrait.

The eyes must be colored, with a small camel's hair brush, to suit the color of the subject. All the form and modeling of the eyes, however, are handled with the air brush. For light yellow hair brown madder or raw sienna are used; a golden brown tone with greys and yellow running through being very effective. Auburn hair calls for burnt sienna, and dark hair, brown or black, is best obtained with sepia and black in combination. Before leaving the face a touch of Alizarin scarlet on the bridge of the nose, in the shadows of the nostrils and at the corners of the mouth should be added with a small camel's hair brush.

Draperies. The colors used will be determined by the instructions in hand. Do not over color. Simply suggest the coloring over the natural textures and modeling of the photographic base. Use softly contrasting tints and avoid raw colors in sharp opposition. Neutral tint is especially useful in mixing these soft colors. Blue and gray are used in the fine shadows of laces and white draperies, the highlights needing a touch of yellow. Use white very sparingly. Prussian blue is generally useful for light blue draperies, a touch of green helping the shadows, tempered with neutral tint. Indigo and black are combined for navy blue and a touch of purple will give life to the shadows. Gold jewelry is colored with hand brush touches of chrome yellow in the lights and burnt sienna in the shadows. Pearls should have a touch of yellow near the highest light and blue in the shadows. A rich, lustrous black is gained by a wash of pure sepia over lampblack.

In changing from the use of one color to another, always put a color cup filled with water on the brush before putting on the new color cup, and thoroughly cleanse the brush. Remove the color from the color cup after use by means of a fountain pen filler and replace the unused portion in the storage bottle for that color. Few changes of color will be needed when the worker gets acquainted with the mixing or combining colors on the print by superposing a wash of one color over another. The expert air-brush colorist also applies the individual colors over all the parts of the print needing them while he is using them and so, in practice, works over the whole print all the time after the first roughing-in has been completed. In this plan, by superposing washes of different colors to secure the desired tones and shades, the whole portrait is gradually "pulled together" in its proper coloring.

Commercial Work. The instructions thus far given have concerned only practice lessons and the finishing of enlarged portraits in monochrome and colors, because the photographer is already familiar with the general handling of this class of work and it therefore offers the simplest way of acquiring a practical knowledge of air-brush manipulation and technique. As skill in this comes by persistent practice the varied usefulness of the air brush as a finishing tool will be more and more appreciated and it can be applied in other and different uses. For example, we may have an order in hand for a series of commercial views of an industrial plant, e. g. a group of buildings. As printed by projection from small negatives, these may exhibit certain shortcomings, such as baldheaded skies, uninteresting foregrounds or obtrusive details, excessive contrasts of color or tone and so on. Such work can be improved one hundred per cent before delivery by the discriminating use of the air brush.

A Practical Example. Let us suppose the prints to be 14 x 17, in black and white. First prepare four color mixtures. Take four 2-oz. bottles. In No. 1 put a good grade of white such as blanc d'argent and sufficient water to give it the consistency of thin cream, but not too thick to go through the air brush quite freely. In

bottle No. 2 put lampblack and white in such proportions as to give a smooth, light grey mixture. In bottle No. 3 make a color mixture somewhat darker than No. 2, and in bottle No. 4 a mixture still darker than No. 3 but not decidedly black. A little azure-cobalt or sepia may be added in mixing Nos. 2, 3 and 4 if necessary to match the bluish-black or brownish-black color of the prints to be worked on.

The surface of the prints to be finished should be prepared by gently rubbing over with any of the solutions mentioned on page 20. If the sky portion of the prints needs treatment, first cut out a cardboard mask to follow and cover the general skyline of the buildings in the view, and fix this over the print. Now roughly tear a few pieces of blotting paper to approximate shapes resembling cloud forms. These, in use, are fixed in the tip of a retouching pencil holder or crayon holder and held in the left hand at a distance of about a quarter of an inch from the sky part of the print. Put a little of mixture No. 2 or No. 3 in the color cup of the brush and adjust the air pressure to about fifteen pounds. Bring the air brush over the sky at the left margin and, at a working distance of two or three inches, begin to cross the sky with an irregular undulatory motion over the top of the cloud form, the left hand holding this and traveling over the sky with the brush motion. A demonstration of this would be better than pages of description; but the idea is to spray cloud forms irregular in outline and shape and varying in depth of tone over the upper portion of the sky space, the lower portion being protected by the cloud templet. The motion of the air brush as it travels across the skyspace will or should be varied in speed and the distance between brush and print should also be varied from moment to moment to give variety of tone. When skillfully done the result will be the representation of soft, indefinite but pleasing cloud masses, effectually breaking up the monotony of the plain sky of the original print. This "clouding" may well form a practice lesson in itself, using a white card evenly tinted as a practice sheet, and will well repay all the time you give it. After clouding the upper portion of the sky as indicated,

clean the brush and, with mixture No. 1 spray a light tint close down to the skyline of the buildings. If this results in the running over of the white upon the buildings, remove the "run-over" with a bluntly pointed eraser.

The Clouding of Backgrounds in small prints, as in sketch portraits with white grounds, is done in the manner here described, varying the form of the templet according to the effect desired. Of course the work on small prints calls for more care in the handling of the brush. The templets used in this small work are sometimes miniature cloud shapes and at other times zig-zag or angular shapes, according to the effect desired. In making the latter, celluloid or thin, hard Bristol board is better than blotting paper as giving a more definite edge, which is desirable. The zig-zag lines or angular forms should always have the same general direction, i. e. should not seem to radiate or spread in fan shape from the head or figure. The small cloud forms and templets, when made of paper, are usually provided with a turned-up edge convenient for gripping between forefinger and thumb of the left hand or inserting in a pencil or charcoal holder when in use.

Working in a Background where a single figure or head is to be copied or enlarged from a group is done as follows. If the original print may be destroyed work directly upon it, otherwise make a slightly enlarged copy and work on that. Glossy development paper will give the best copy print for after reproduction. Mount the print with paste or starch and clean the surface thoroughly with weak ammonia water. Procure a sheet or two of frisket paper and a small supply of rubber cement of good quality. Apply the cement to all the portions of the portrait (head, face, etc.) which are to be protected from air-brush work and lay a piece of the frisket paper (a thin, transparent mask paper) over the cemented parts. Rub the paper down until it adheres perfectly. Take a sharp-edged knife or safety razor blade and cut carefully and gently through the frisket mask all around the hair, head and figure to be protected. Remove all the paper except that covering the figure—by peeling, and carefully rub off the

cement at the edges of the mask and on the whole of the print outside the protected parts. The cement will readily peel under the application of the finger tips. When thoroughly cleared of any trace of cement the print will now "take" the air-brush work perfectly. Now take mixture No. 3 or No. 4, according to the general tone of the ground suited to the subject in hand and lay an even tint over the whole of the background of the figure. This done and thoroughly dry, take mixture No. 2 or No. 3, as may be appropriate, and with a circular or wavy motion and the use of cloud forms, lay a loose, uneven tint over the ground already worked in the background. The general scheme of the background, whether clouded or varied in tone by differing depths of shading in parts, may be left to the choice of the worker. A little practice on these lines will quickly give the desired facility in working in grounds well adapted for copying and useful in other branches of reproduction work, photographs of commercial articles such as machinery, automobiles and the like. The introduction of designed grounds for combination groups and commercial work (as the skillful combination of an automobile pasted on a landscape or street scene in correct position and perspective for advertising purposes) is done by this method. The color or tone of the mixtures used should, of course, match the tone or color of the copy print as closely as possible. When all the air-brush work needed has been done, insert a thin knife blade under the frisket mask covering the head or figure and peel it away quietly and with care. Allow the cement covering the protected part to dry a few moments and then rub it off cleanly with the finger tips. If the work has been carefully and well carried through, you will now have the figure or subject to be copied isolated and attractively set against a suitable background and the final copies may be made in any desired size.

Frisket Paper and Masks. The use of frisket paper, supplied by any air brush manufacturer, is very simple when once the way of applying and removing it has been acquired by experimental practice on waste prints. But it is used only where it is desired to work right up

to the outline of a subject for finishing or copying. Otherwise a card, celluloid, paper mask or form, of the required shape or curve, is generally used to protect the parts not to be worked on.

Matching Combined or Pasted Prints. When prints are combined by pasting, as when a single cut-out figure is added to a group, or a cut-out automobile pasted on to a roadway scene, the hard, white edge of the cut-out is blended as follows. Take black or sepia crayon sauce of the same color as the print and a flat bristle brush about one-quarter or three-eighths of an inch wide. Charge the brush well with the crayon sauce and try it on a smooth card to ensure freedom from grit or lumps. Then vigorously brush the white edges of the cut-out until its whiteness completely disappears. Now take a sharply pointed rubber and stipple any over-dark portions apparent along the outlines of the cut-out. Finally spray with the air brush charged with a suitable color, finishing with a light spray of gum water over the whole print.

Matching Uneven Portions of Prints. It will often happen that enlarged prints, whether of portraits or commercial subjects, will show large portions of uneven color or tone. For example: sometimes portions of drapery in a figure will be too light in tone; or a white dress may lack detail; or the sleeve or lower front of a man's coat may be weak in tone or formless. The air brush, charged with mixtures 2, 3, or 4 (see page 29) as the case may require, will remedy these effects. This sort of work is best learned by practice on a few waste prints exhibiting the defects mentioned. By working with lampblack or sepia, the work done may be washed off with water if unsatisfactory and the coloring or shading repeated as often as may be needed until the desired skill or finished result is obtained. The effectiveness of this use of the air brush depends upon the skill of the worker in producing the desired result with as little color and work as possible. Avoid loading the print with color and making the brush work too obvious. Use a light spray, setting the brush for a line and working as far away as is practical.

In the same manner all sorts of obtrusive details in

a print, whether of actual objects or objectionable faults of lighting, reflections in interiors, spotty outdoor backgrounds and the like, can be softened or subdued in tone or removed altogether. Hand masks of different shapes and sizes, the outlines of which offer every variety of long and short curves, angles and lines, are much used in this class of print improvement. Not always must the mask be cemented to the print, save in working elaborate changes in a large print to be afterwards rephotographed to a required size. Generally it will suffice to hold the mask or templet close to the print in the left hand, moving it as the work proceeds.

The Air Brush in Pictorial Photography. Convincing proof that the air brush is an art tool rather than a mechanical brush is seen in its intelligent use in pictorial photography, whether this be followed according to the methods of earlier days by combining parts of several negatives to form the final print (as in the work of H. P. Robinson, A. Horsley Hinton and A. R. McNaughton), or employing the soft, diffused effects in vogue today. In either method the best effects are obtained by working upon an enlarged print or negative and then rephotographing this down to the desired size, using a rough surface paper for the production of the final prints. The Kilmer method of making the enlargement negative on a development paper such as Artura Iris, given in *Studio Light*, October, 1920, is well adapted for making large negatives for air-brush work and printing by reduction.

The actual manipulation of the print in such a case will vary according to the taste and skill of the pictorialist, who alone knows what is wanted by way of addition, elimination, subordination or accentuation in the subject before him. Thus skies may be introduced or improved; uninteresting masses given variety of tone or detail; obtrusive details softened or eliminated, weak portions strengthened and additions (printed in or pasted on) blended and harmonized with their surrounding parts. The most perfect work of this sort is done by making an enlarged transparency of the original on glass and working on this with the air brush and

transparent dyes, opaques etc. From this worked transparency a negative is made by reduction to any size desired and the final prints made from this on a rough paper surface.

Always, before beginning air brush work on a bromide print, clean the surface by lightly rubbing it over with wood alcohol or one of the mixtures given on page 20, in order to ensure a grease-free, working surface. In the case of large prints finished with the air brush, a coat of artist's fixative (1 ounce of best white shellac dissolved in 7 ounces denatured or wood alcohol, the clear portion being decanted after the mixture has been well shaken frequently and allowed to stand for a day or two), should be applied to the whole print, which should then be vigorously rubbed with a tuft of cotton wetted with waxing compound. It is better to apply this fixative with an artist's fixative sprayer, and so avoid the troublesome cleaning of the air brush with alcohol necessary after the use of a shellac varnish. In some instances the air-brushed print can be improved, before applying the shellac, by picking out the highlights or brightening them with a sharply pointed rubber eraser. But don't overdo this or the result will be a spotty print.

Air Brush Work on Negatives. When by persistent practice on paper and photographic prints, the photographer has gained a practical knowledge of air brush manipulation, he can profitably begin to use the air brush in retouching and improving negatives. The special difficulties in this work are the application of liquid colors to a non-absorptive surface such as the glass side of a negative or upon a gelatine film or ground glass varnish, and the use of transparent colors, dyes and opaques for their light-resisting effects.

Preparing the Surface. If the work is to be done on the glass side of the negative, it is imperative that this shall be thoroughly clean. This is best done with a tuft of cotton or soft rag wetted with a strong soda or ammonia water solution, finishing with wood alcohol. Hard spots of emulsion or gelatine should first be scraped off with a knife blade. Perfect cleanliness of the glass surface being assured, the negative should be kept

moderately warm while being worked on, so that the color spray will dry as fast as applied, and a very fine, light spray is employed. Any unsatisfactory work done on the glass side of the negative can, of course, be removed instantly with a tuft of cotton and water, it being presumed that the colors used will not be of the waterproof kind. If the work is to be done on the gelatine film side of the negative or, as is often recommended, on a separate piece of flat film or celluloid which is placed as a screen in front of the negative during printing, i. e. in contact with the glass side (with the object of softening the definition of the air-brush work), the gelatine film is first cleaned with a tuft of cotton wetted with alcohol to ensure a surface free from grease or color-repelling patches. Work on such a film surface cannot be removed completely by washing when dyes are employed, but small defects, spots of heavy color, etc., both on film and glass, can be softened or picked out with a sharp pointed rubber eraser or stomp and cuttle-fish powder. Ground glass varnish, used as a base for air-brush work on negatives, should be of a good, fine-grained quality and carefully applied to secure a thin, even film. Let it thoroughly harden and keep the negative slightly warm while working on it, avoiding repeated strokes on any particular portion of the plate until the previous color deposit is thoroughly dry. In the case of mistakes on a ground-glass base the whole of the varnish must be removed, save in exceptional instances where the skillful use of an etching knife will remedy the error.

The Colors used for negative work are transparent yellow, orange and red or aniline dyes of these hues, a thoroughly mixed, fluid white and finely ground photographic opaque or draughtsman's india ink. The last three should be filtered through fine muslin to ensure freedom from grit, and the bottle containing the liquid white should have a few small lead shot or small pieces of lead in it so that, when well shaken, a smooth mixture free from lumps will be secured.

Method of Use. The negative to be air brushed is placed on a retouching easel or desk, with sufficient reflected light coming through it to enable the operator

to see the effect of his work at every point—as in retouching with a pencil. Small masks of suitable form, held in the left hand or lightly held on the negative over any parts to be protected, are used as necessity indicates. The color cup on the brush is filled with the color, dye or liquid opaque to be used. This should be of the consistency of ink. The brush is set for a line and the air pressure should not exceed fifteen or twenty pounds as giving better control of the color. If there is any tendency to spluttering of color or unevenness of deposit, remove the color cup, fill a clean cup with water and thoroughly cleanse the brush at a pressure of twenty-five pounds.

Thin portions of negatives which print too quickly, thin skies or foregrounds, a mass of trees or a dark doorway in an interior and so on can be held back (intensified as to printing density) with a few strokes of the brush charged with yellow. Details requiring more density or cloud forms in skies may be strengthened with orange. Portions which should be rendered very light in tone or eliminated are treated with red or opaque. The use of liquid white for skies, in place of yellow dye or opaque, is favored by some workers as giving more delicate shadings of tone or density. The choice of the dye or color used must be left to the worker's practical knowledge of their density giving capacities. Of course, they may be diluted to any desired strength, which will vary according to the density of the negative being worked upon. The object always should be to get the required density or result required in as few strokes as possible, without repetition, to avoid softening or deterioration of the ground glass or gelatine film surfaces. In portrait work the mask used to protect any portion of the figure is usually made by cutting out a collodion paper print or traced design on plain paper. A gelatine paper print, if used as a mask, is liable to get dampened and adhere to the negative. To the operator with a little facility all the air-brush work required by the average negative, such as strengthening the shadows, laying-in a tint over an unexposed portion or brightening up a weak sky, can be done in a few minutes. This facility cannot be

had by any amount of book reading, but only by practice on the negative itself along the lines here indicated.

Putting in Backgrounds with the air brush, by which is meant working a background of definite design into a portrait negative having a transparent ground behind the figure, is quite practicable, but involves a knowledge of drawing and perspective and is, at best, somewhat tedious and difficult in the doing. Generally, too, the results are of questionable worth. The difficulties can be minimized by confining the effort to introducing a mere suggestion of form or design, rather than attempting (as is too often done) to work in the traditional studio ground catalogued as a "Reynolds" or "Gainsborough," with unsubstantial pillars and draperies in the foreground and a "Corot landscape" in the distance. I recall the instance of a prominent New York photographer, specializing in home portraiture, who made successful, because restrained, use of the method when he was obliged to photograph his subjects against a mass of incongruous wall or room decoration. But he has since abandoned it as undesirable because of its artificiality.

The Method of working-in such a ground by the old hand procedure was described and illustrated in THE PHOTO-MINIATURE No 126, now out of print. In using the air brush for the work, there is the same need of a predetermined design and suitable forms for the introduction of the details of the design, such as pillars, windows, or similar features. The "color" used will generally be one or other of the mixtures 2, 3, or 4 (page 29) as required by the design and the character of the negative worked on.

It is, however, very desirable that the beginner should first practice this background painting with white on 8 x 10 sheets of smooth black paper such as is used for wrapping plates and sensitized papers, so that he may acquire a correct sense of the values of light and shade reversed as they are in a negative.

Here would be the procedure for a background having two massive marble pillars on a rectangular base in the foreground, with a heavy curtain draped

over the left hand and upper corner (this combination occupying the left-hand third of the space). Beyond the pillars we see a rolling landscape with trees and a well-clouded sky filling the other two-thirds of the picture space.

Mount an 8 x 10 sheet of black paper and fix it on the easel board. Fix a cardboard form cut to the size and outline of the curtained pillars over the left-hand third of the practice sheet. Now, with white water color in the color cup, the brush set to a line and the air pressure at twenty pounds, lay in the highest light where you have previously sketched the horizon in the landscape to begin. Work over to the right indicating the tree forms and light of the sky between the branches. Now work in the whole of the sky with varying depths of color and the suggestion of cloud forms. Lay in the foreground with light strokes, barely covering the black tone of the paper, but indicating a pathway leading into the center of the lower half of the picture. Remove the form protecting the space reserved for the pillars and curtains, run a broad light down the center of the pillars, shading this off gradually to their outlines to give them roundness and relief. Put in the high-lights and half-lights indicating the outlines, mouldings, paneling and markings of the marble base, using the straight edge of your mask or form for the lines of the base. Now place the lights and half-lights on the curtain until it hangs properly with the feeling and texture of drapery, and your ground is complete. If the edge of the pillar against the sky is too hard, a few up and down strokes with the brush at three or four inches away will soften the edge and help it to fall into place. The abomination is now complete.

Without a doubt the first attempts of the untrained man at this kind of work will be crude in result. But persistent practice will mend matters and in a little while you will get "the hang of it," so that you can begin work on a negative with confidence in your ability to produce reasonably good work.

Coating Gum Bichromate Papers. Until I looked into the books a few months ago, I had imagined that the credit for first suggesting and using the air brush for

the coating of gum bichromate papers was due to the late Walter Zimmerman, who described his method in THE PHOTO-MINIATURE: No. 113 (October, 1910). Zimmerman, however, was anticipated by H. E. Blackburn who, in the April, 1908 issue of *Camera Craft* asserts his preference for the air brush for this method of preparing "gum" papers, as superior to the old-style brush coating. Long before either Blackburn or Zimmerman, the veteran photographer W. H. Sherman patented in 1885 a method of producing photographs in permanent pigments in which the gelatinous pigment mixture was blown "upon the paper to be coated by means of a physician's atomizer, operated by a continuous stream of compressed air supplied from an air pump or it may be applied by means of an air brush." The "air brush" here mentioned must have been an early form of the Walkup brush which, in its present design, was patented in 1885–86. Blackburn and Zimmerman used the Wold Air Brush—apparently a model generally employed for the spraying of oil colors or fairly thick liquids.

The Method. There is no special trick in the use of the air brush for coating gum pigment papers, except that the gum solution should be perfectly smooth, free from lumps or grit and not too thick or heavy. As matter of course, the gum-pigment mixture should be thoroughly filtered through muslin before using in an air brush. The paper for coating by air brush is preferably fixed vertically against a wall or board larger than the sheet to be coated. As a time-saving convenience Zimmerman advises that paper should be coated in full-size sheets and not in small pieces cut to size for use. Begin the coating by a steady, continuous movement of the brush across the sheet, using at first a very light air pressure which may later be increased, and holding the brush about a foot away from the paper. As soon as the whole sheet has been coated in one continuous movement, repeat the coating but this time work from left to right, up and down the sheet from top to bottom.

After the Use of the Air Brush with any thick, gelatinous mixture, the thorough cleansing of the brush

with warm water is an absolute necessity as the gummy mixture, if allowed to dry, will certainly clog the brush and give trouble in after use.

The Advantages of the air brush, as compared with the ordinary hand coating brush, for this purpose are many and obvious. The pigmented color spray thrown on the paper dries almost instantly, so that a coating is ready for use at once, or repeated coatings can be given in a much shorter time than with the old-style brush. The air brush coating, too, is more even and uniform in thickness than the hand brush will give, and the less exposed portions of the picture image wash out more easily in development. This last is particularly advantageous where, as in modern practice, the gum print is developed by simple soaking rather than by brushing or scrubbing. The pigment, to be sure, is embedded in the fibres of the paper, but it is more on the surface than with the old method of coating, so that the lighter portions of the picture are not so liable to be stained or degraded in tint. The air brush coating method is especially advantageous in preparing thin papers, such as onion skin, thin bonds or Japanese tissues for gum printing, wherein hand brush coating gives rise to creases, wrinkles and other difficulties. It is advised, in coating such papers, to use a fairly heavily pigmented solution with a single coating, as obviating the tendency of such papers to shrink, which makes registration difficult in multi-color gum printing.

With this our discussion of the usefulness of the air brush to the photographer draws to its end. Grateful acknowledgment is here made of the practical help and information supplied by Mr. Samuel W. Frazer and Dr. T. O'Conor Sloane in the preparation of the monograph, as well as to the makers of the various air brushes at present available for the loan of blocks illustrating their brushes.

BOOKS

THE AIR BRUSH IN PHOTOGRAPHY. By G. F. Stine. 144 pages, illustrated. 1920. $3.50.

A TREATISE ON THE AIR BRUSH. By Samuel W. Fraser. 66 pages, illustrated. 1915. $1.50.

Notes and Comment

To the Reader. In order to avoid further delay in publication, many interesting "Notes," "Reviews" and "Exhibitions" are omitted from this already overfilled issue of The Photo-Miniature. They will be published in the April issue, which I am boldly promising will reach the reader within thirty days after this meets his eye. The irregularity in the publication of the magazine has been a dire distress to all concerned, but was unavoidable in the circumstances. I think, however, that we have reached an end of the difficulties and that The Photo-Miniature will be published more frequently and more regularly from this date forward.

U. S. vs. E. K. Co. The withdrawal of the appeal of the Eastman Kodak Co. to the Supreme Court of the United States against the decree of the Federal District Court of New York, handed down in 1915, and its acceptance of the decree, has aroused much curiosity as to the future development of the Company. The subjoined statement issued by the Kodak Co. to the photographic trade is therefore interesting as giving the present status and probable future policy of the Company.

Rochester, Feb. 5, 1921.

Our government suit has been settled. This is to tell you just how it has been settled.

Under the decree which we have accepted, we are to sell certain specified Divisions of our business, in some cases including the factories.

What is known as the Folmer & Schwing-Century Division is to be sold, including the trade names Graflex, Graphic and Century, and also including the factory with all tools and equipment.

Similarly we are to sell the Premo factory and equipment and trade name Premo.

The trade name Artura is to be sold and with it we are to disclose to the purchaser the Artura formula.

We are also to sell the trade names, Seed, Stanley and Standard, and disclose to the purchasers of those trade names the formulæ for those brands of plates.

If an intending purchaser of the disclosure of one of the formulas is desirous of purchasing a factory as well, we are to sell the American Aristo plant at Jamestown at a fair and reasonable price.

By the terms of the settlement, we are to have two years in which to make such sales. If at the end of that time the sales have not been made, the properties are to be put up at auction, but with a minimum price to be agreed upon between the government and ourselves.

Dealers in and users of the products that are affected by this decree will, first of all, be interested as to whether or not they are to continue to receive them without interruption. Of this they can rest assured.

The two camera factories affected will be operated by us to the fullest possible extent until a sale has been made, and similarly, we shall continue to supply Artura Paper and, under their original trade names, such of the brands of Seed, Standard and Stanley plates as we purchased. Certain of the products now marketed under the Seed, Stanley and Standard names were, however, originated in our own factories, were not a part of our purchase from the Seed, Stanley or Standard companies, are not therefore subject to the court order and will, at the earliest possible date, be marketed under new trade names. The most important of these products are the Seed 30 Plate, the Seed Graflex Plate, the Seed Panchromatic Plate, the Seed X-Ray Plates, the Stanley Commercial Plates, the Standard Polychrome Plates, the Standard Post Card Plates and the Standard Lantern Slide Plates.

It is the avowed object of the Sherman law to provide for the widest possible competition. Obviously, then, we are not prohibited from making paper and plates to compete with the brands that we part with. On the other hand, we are expected to compete with them.

This we shall do and in the case of paper and plates, we shall have every facility that we now have, the "Know how," the same plant, and the same men. It will be for the consumer to decide who makes the best goods—those to whom we disclose our formulæ and sell our trade-marks or we ourselves.

So far as the cameras are concerned, the conditions are different. We are to sell factories and machinery and tools and goods in process as well as the trade names. Obviously, we cannot immediately come out with competing lines.

All this will make no difference, however, in the steady flow of goods to you. We intend that the trade and the public shall not be inconvenienced. There will be Graflex and Premo Catalogues and advertising of those lines as in the past.

In many respects, we shall presently be in a better position than ever, to go on with our development of photography. Many elements of doubt and uncertainty are removed. The manufacturing ends of our Kodak Park, our Camera Works (where Kodaks and Brownies are made), and Hawk-Eye plant, where we manufacture lenses, are unaffected. The organization of our sensitized goods department, both manufacturing and selling, remains intact.

The newspaper reports of this settlement of the Government suit may have disturbed you, may have in a measure destroyed your confidence as to the future. You have now had the story straight. We have, because we want you to have the same confidence that we have, told you fully and frankly just what the situation is.

Doubt, uncertainty—they are behind us. We are in a position to serve. You are in a position to join us in the big drive for the development of more business.

EASTMAN KODAK COMPANY.

A BRITISH AMALGAMATION. Seven prominent British photographic and optical firms, viz. The Paget Dry Plate Co. Ltd., Rajar Ltd., Marion and Co. Ltd., Marion and Foulger Ltd., A. Kershaw and Son Ltd., the Kershaw Optical Co. Ltd., and the Rotary Photo-

graphic Co. Ltd., have fused their respective interests by incorporating as Amalgamated Photographic Manufacturers Ltd. The authorized share capital of the new company is stated as £1,100,000 (approximately $4,400,000) of which 250,000 10 per cent participating cumulative preference shares of £1 each are offered for public subscription. The purpose of the amalgamation is stated to be the more ready development of the foreign and domestic trade of the concerns involved, with the introduction of substantial economies in the manufacture and sale of their products.

F. E. Ogden, whose many admirable qualities won him a host of friends while he was connected with the Herbert & Huesgen Co., is now in charge of the photographic department of Schoenig & Co., 8 East 42nd Street, New York. An amateur of uncommon skill, Mr. Odgen's specialty of the moment is the production of enlargements which bring out all the pictorial quality his eye can discern in the tiny originals committed to his care.

Ciba. This is a new trade name likely to become familiar among American photographers during the coming years. It is an abbreviation of the title of the Society of Chemical Industry in Basle, Switzerland, one of the largest chemical concerns in Europe, with a manufacturing plant which dominates the city of Basle as the Kodak plant dominates Rochester—by sheer mileage. Ciba Company, Inc., of 91 Barclay Street, New York, the Sales Agents for the Ciba products, is wholly an American Company.

The Ciba specialties thus far announced comprise Metagol, "Ciba" (a chemically pure monomethylparamidophenol sulphate), Diamidophenol "Ciba;" Glycin "Ciba;" Paramidophenol "Ciba;" Hydroquinone "Ciba;" Pyrogallic Acid "Ciba" (Resublimed)—a complete line of photographic developers for plates, films, lantern slides and papers, with a high reputation abroad for purity and reliability. A descriptive booklet,

with many useful formulas for special developers, combinations of developers, etc., can be had from Ciba Company, Inc., on request.

A New Soft Focus Lens, or rather, a new supplementary lens which converts any anastigmat to which it is fitted into a soft focus lens of the most desirable sort, is to be introduced shortly by the Pinkham & Smith Company, 290 Boylston Street, Boston, Mass. I hope to have detailed information about the lens in the forthcoming issue of The Photo-Miniature.

Heyde's Actino Photo Meter. Many readers who have seen this well-known exposure meter (advertised in The Photo-Miniature and other journals at $10) offered at various prices ranging from $5 to $7.50, have asked for the facts in the case. These are briefly: The Herbert & Huesgen Co., of New York, are the exclusive representatives in America of the German maker of this meter, Gustav Heyde, of Dresden. As such they arranged to place on this market the latest, improved form of the Heyde meter, with an exposure dial calibrated to give the correct exposures in accordance with the lens diaphragm scales universally used on American cameras. The selling price was fixed at $10, which allowed the importers and trade generally a reasonable profit on its sale. Thereafter someone without ethical scruples proceeded to import a lot of the meters as made for sale and use in Germany, fitted for the Continental diaphragm system which differs from that used in this country. Taking unfair advantage of the demand in this country, created solely by the advertising of the authorized import agents, the aforesaid someone without ethical scruples, is unloading the model made for use in Germany (and hopelessly confusing to users of American cameras) at various "cut prices." It is a bad bargain and the Herbert & Huesgen model, with the American dial and instruction book is more than ever worth its price as the simplest and best solution of the problem of exposure.

Books and Prints

PICTORIAL PHOTOGRAPHY IN AMERICA 1921. 73 pages; 56 plates; 8 x 11 inches; paper boards, $3. Published by The Pictorial Photographers of America, New York. Obtainable from Tennant and Ward, New York, or dealers generally.

The Pictorial Photographers of America is the title of an association composed of about four hundred amateur and professional photographers scattered throughout many states and Canada, which has for its single purpose the stimulation and encouragement of all interested in the art of photography. The association has its headquarters at the National Arts Club, New York. Its activities are directed by Mr. Clarence H. White, aided by a group of earnest workers who are unsparing in their devotion to the organization and its purpose. These activities comprise regular meetings, with addresses or demonstrations covering a chosen phase of photography; the promotion and routing of exhibitions of pictorial photography in America, and the publication of an annual illustrating and recording the progress of pictorial photography in America. As such the organization seeks and richly deserves the good will and coöperation of all interested in the development of photography.

The volume here briefly noticed is the second annual published by the association, a labor of love on the part of all concerned in its making, and published at the bare cost of production without intention or hope of profit. It is a book of rare and unusual interest for anyone confessing to pictorial aspirations, offering as it does, not only an inspiring exhibition of current American pictorial work, but also some account of how the pictures were made, with an illuminating report on "The Year's Progress" by Clarence H. White, and an uplifting page, headed "Painting With Light," by Arthur Wesley Dow.

To attempt any detailed review here, without the pictures before us, would be futile and unprofitable. As reproductions, the illustrations are the best we have had since Alfred Stieglitz discontinued his amazing "Camera Work." In format, printing and binding, the volume is a delight to the eye.

I note with pleasure that the woolly, smudgy effects resulting from the abuse of the soft-focus lens, so conspicuous in last year's volume, are less in evidence in this. Doubtless this is in part due to better presswork; but I am hopeful that it is also a sign that our American pictorialists are becoming more discriminating in the art of focusing (or shall I say, delineation?), and in the proper use of the lens—whether anastigmat or "soft focus." In their subjects the pictures show a wide variety of interests, with perhaps a preference for the pictorial treatment of architectural detail. The portraits are few in number, unconvincing and lacking in distinction. The outdoor scenes and story-telling pictures still show too much of unrelieved and uninteresting blackness and fog for my fancy, but there are notable exceptions. It would seem as if our pictorialists loved gloom and mystery overmuch, forever setting out on their picture making at eventide. The strongest work in the book is found in the few pictures which show the play of sunlight.

WALL'S DICTIONARY OF PHOTOGRAPHY. Tenth edition, 1920. Edited and largely rewritten by F. J. Mortimer. 700 pages; 2,000 references. Cloth $5. American Sales Agents: Tennant and Ward, New York.

The appearance of a new and up-to-date edition of this standard reference book will be welcomed by professional and amateur photographers alike. In its comprehensive fullness of detail, as well as in the quality and reliability of its information, Wall's "Dictionary" has always been unequaled among the books of its kind, and its growth from the slender volume published twenty years ago to the present bulky tome of 700 closely printed pages represents the labors of many photographic workers and writers of prominence. It is

essentially a resumé of working processes, methods and formulæ, many of which are dealt with in such completeness that the "Dictionary" belies its name, and might better be described as a library of little handbooks in a single volume. By careful compression and judicious editing, however, Mr. Mortimer has succeeded in covering the whole field of photography within its ample bulk, so that all the information offered by its two thousand items is made instantly accessible. The busy reader, especially, will be grateful for the elaborate system of cross reference introduced in this edition. As the only work of general reference at present available, apart from its merit as the best of its kind, it should find a place on the workroom bookshelf of every photographer.

The British Journal Almanac, 1921. Diamond Jubilee Issue. Edited by George E. Brown, F. I. C. Paper covers, $1. Cloth bound $1.50. London: Greenwood & Co. American Trade Agents: George Murphy, Inc., New York.

Better than ever and more indispensable than ever must be my brief comment on this Jubilee Volume of the "Almanac." Apart from the regular comprehensive digests of the year's methods, formulas and processes, apparatus and whatnot, Editor Brown offers a capital handbook for beginners under the title "More Photography" and, as a new feature, has reformed the Calendar in an amazing way. By all means get a copy—if you can.

FAYETTE J. CLUTE

With a keen sense of personal loss I record the death of Fayette J. Clute, for many years Editor of *Camera Craft*, of San Francisco, which took place January 31st, after a painful illness borne with heroic patience and fortitude. R. I. P.

FIG. 24. Untouched photograph, showing effect of using screen in Fig. 23. See page 84

Fig. 23. Screen Stand. See page 84

FIG. 20. A Cosy Corner. See page 70

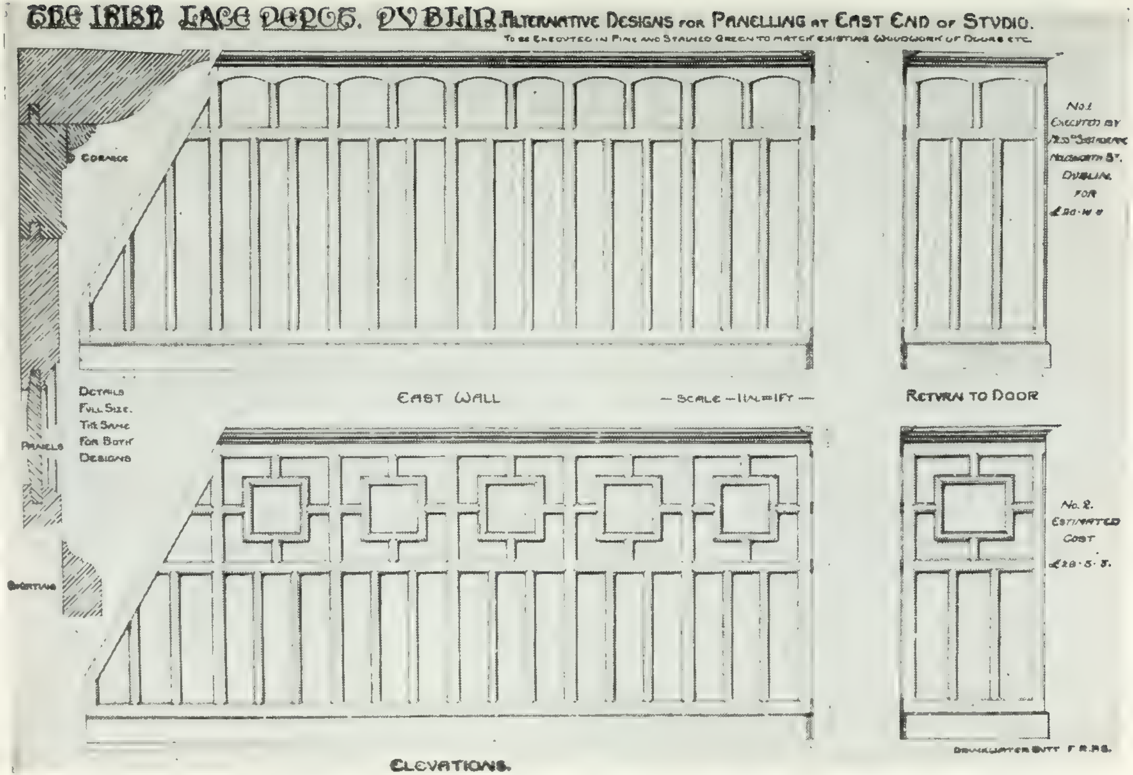

FIG. 19. Two Designs, by the Author, for Studio Wall Paneling. See page 78

FIG 12. Studio Designed by the Author for Figure and Group Compositions (Commercial). See pages 69 and 78

Fig. 9. Studio of Mr. Drinkwater Butt. See page 78

PHOTOGRAPHIC PHENOMENA, OR THE NEW SCHOOL OF PORTRAIT-PAINTING.

FIG. 1. The Portrait Studio of 1844.
By George Cruikshank

The Photo-Miniature
A Magazine of Photographic Information
EDITED BY JOHN A. TENNANT
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The Studio: Its Design, Construction and Equipment

From the early days of portrait photography, when, by the way, it was usually called the "operating room" in America, and the "glass house" in England, the photographic studio has been a matter of great concern to those who have had to use it. Hence, a very large amount of thought, time, and trouble has been given, sometimes in mistaken directions, to its design, construction, and equipment. In the following pages it is proposed to deal not only with its evolution and development, but also with the results of such development in modern practice.

The earliest illustration of a photographic studio which I have been able to find is in the form of a woodcut by George Cruikshank, which appeared in his periodical *The Omnibus*, for the year 1844, a reproduction of which appears in Fig. 1. It shows a semi-circular apartment, the sitter being placed at the central point, against what was probably the north wall, on a raised platform so as to bring him as near as possible to the source of light, apparently a completely glazed and nearly flat roof, in view of the long exposure required by the Daguerreotype process then in use. The presence of the head-rest, to help him to keep steady during the said exposure, is also thus early to be noted. That the modeling received some attention is shown by the opaque head-screen and what looks like a transparent

blind suspended from the roof, but this was probably subsidiary to the desire for all possible light to shorten the tiresome ordeal of sitting. The camera is either one or both of the boxes on the shelf, probably both, as the process being a direct positive one, a sitting was necessary for every copy required; and standing by is the operator with a plate-box or holder in one hand, and in the other a watch to time the endurance of the victim in the chair. The individual to the right is polishing the silvered plate with the buff-stick, a necessary and important part of the process, and those to the left are apparently examining finished specimens through hand-glasses. Beyond is the developing-room, in which are to be noted the burning spirit lamp and other adjuncts of the process, while behind the operator are other sitters awaiting their turn. The scene has apparently been sketched on the spot and is doubtless an accurate record of the facts. In the magazine the woodcut is accompanied by some lengthy verses, the humor of which is, however, so much of a bygone day that I forbear quotation.

Monckhoven's Studio. It was not, however, until the introduction of the wet collodion process, with its accompanying possibility of the multiplication of paper prints from the negative so produced, that photographic portraiture became really popular and studios numerous. One of the earliest of these was that of Monckhoven, an isometric projection of which appears in Fig. 2. As will be seen from the illustration, this had a high front light, which, now that direct sunlight was no longer necessary, came from the north, with the addition of lighting areas at the two sides, so that either side of the sitter's face could be lighted at will. This was a distinct advance in the matter of modeling, and made the studio fairly well suited to the needs of the time and of the men who used similar structures, but who were probably more often occupied with the defects and difficulties of the "wet" process, such as spots, pinholes, comets, and oyster-shell markings, than with problems of artistic lighting and modeling. The chief point of interest in this design, however, is the provision of what was known as the "tunnel" or dark portion

facing the sitter, in which the camera and operator were placed. The idea of this was partly that, the camera being in darkness, the operator could see to focus without the aid of a cloth, and partly that the eyes of the sitter, looking into the dark space, might be less dazzled by the strong front light, and the consequent contraction of the pupil was to some extent avoided. It was also contended that the arrangement tended to produce a "restful expression" on the part of the sitter, though many photographers finally found that the looking into a dark tunnel, where a brown-fingered professor of the "black art" performed mysterious evolutions in the gloom, had rather an opposite effect on nervous ladies and children.

Stuart Wortley's Studio. Many modifications of this form of studio were, however, tried, including some with the "tunnel" made so low, in order not to interfere with the large top front light, that the operator had to stoop all the time; and among the most successful of these was the studio of Colonel Stuart Wortley, of which a plan and side elevation are shown in Fig. 3.

The studio portion proper was about 12 by 15 feet on plan, with the unlighted portion extending about 23 feet in a northerly direction. The sloping front light was of clear glass at about an angle of 45 degrees and the further side of the studio, that is the one opposite to the elevation shown, was glazed with corrugated glass up to 7 feet from the ground and from thence to the roof with clear glass. The building, like most of the early studios, was merely a light wooden structure, with a felt roof, and quite devoid of any internal or external decoration. It, had, however, what was then a quite notable improvement, namely, two sets of blinds, one white and the other black, over the whole of the glazed portions. Still it cannot have been a very easy studio to work in, and when decent modeling had been obtained the difficulty of obtaining sufficient light must have been present. The only thing that the "tunnel" studios can have been really suitable for must have been copying, and for that purpose I believe some modifications of it are in use to the present day.

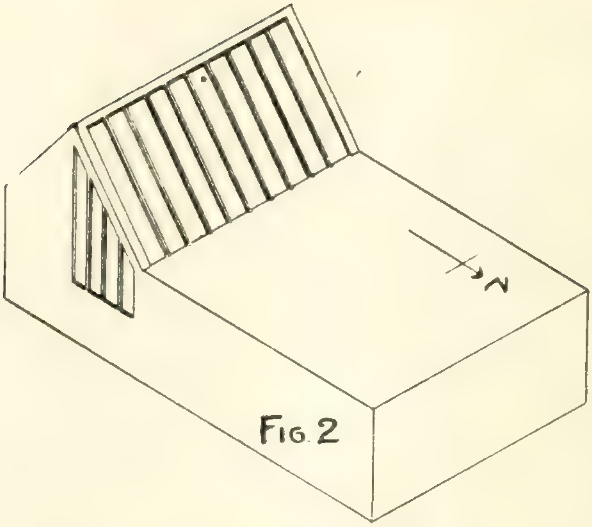
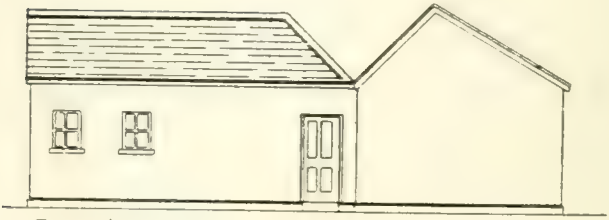


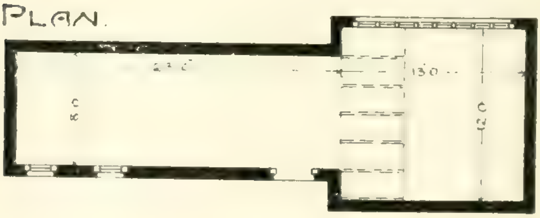
FIG. 2



ELEVATION.

FIG. 3.

PLAN.



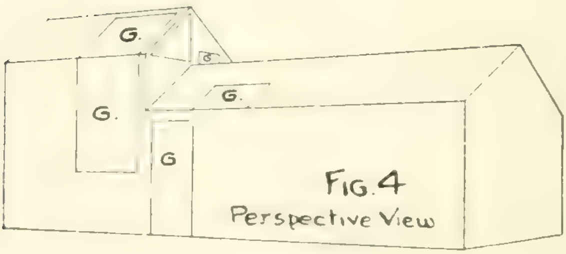


FIG. 4
Perspective View

Rejlander's Studio. On many, or indeed most, of these experimental studios of the past, it is not necessary to waste time and space, but any sketch of the history of studio-building would be incomplete without mention of the celebrated one of Rejlander, (Fig 4.) in which his composite picture "Two Ways of Life" and other well-known photographs were produced. To his early training as a graphic artist Rejlander added many years of study as an amateur photographer and in designing his studio he was probably as much influenced by one art as the other, and made his arrangements to obtain, if possible, in his photographs the painter-like effects of lighting which he sought. The building, which was of corrugated iron lined with match-boarding, was about 30 feet long, the portion devoted to the sitter being some 10 feet square. The lighting was obtained from the spaces marked G on the diagram, which were all, including the door, glazed with clear glass. On the side not seen in the sketch there were no lights at all, but the interior was painted white to get reflected light on the shadow side of the sitter. The three smaller lights were generally covered with transparent blinds, their object being not to get direct but diffused light to soften the shadows. The sitter was, therefore, lighted mainly from the top and side top, too much front and direct light being avoided. This studio must have been a good deal better to work in than some of its predecessors, but, of course, owed much of its success to the talent of its user, as was shown by the fact of many imitators trying to make use of similar places but failing to produce similar results.

The studio of another famous early artist and photographer, D. O. Hill, was probably very much of this type, but research has failed to produce exact details of it, though many of the "Calotype" portraits produced in it are still extant and would hold their own in any exhibition of pictorial work today. These two last named men were, of course, more artists than professional photographers. When the latter began to increase and multiply, as they naturally did during the mid-Victorian vogue of the *carte-de-visite*, which was started by the fancy of the Duke of Parma to have his portrait

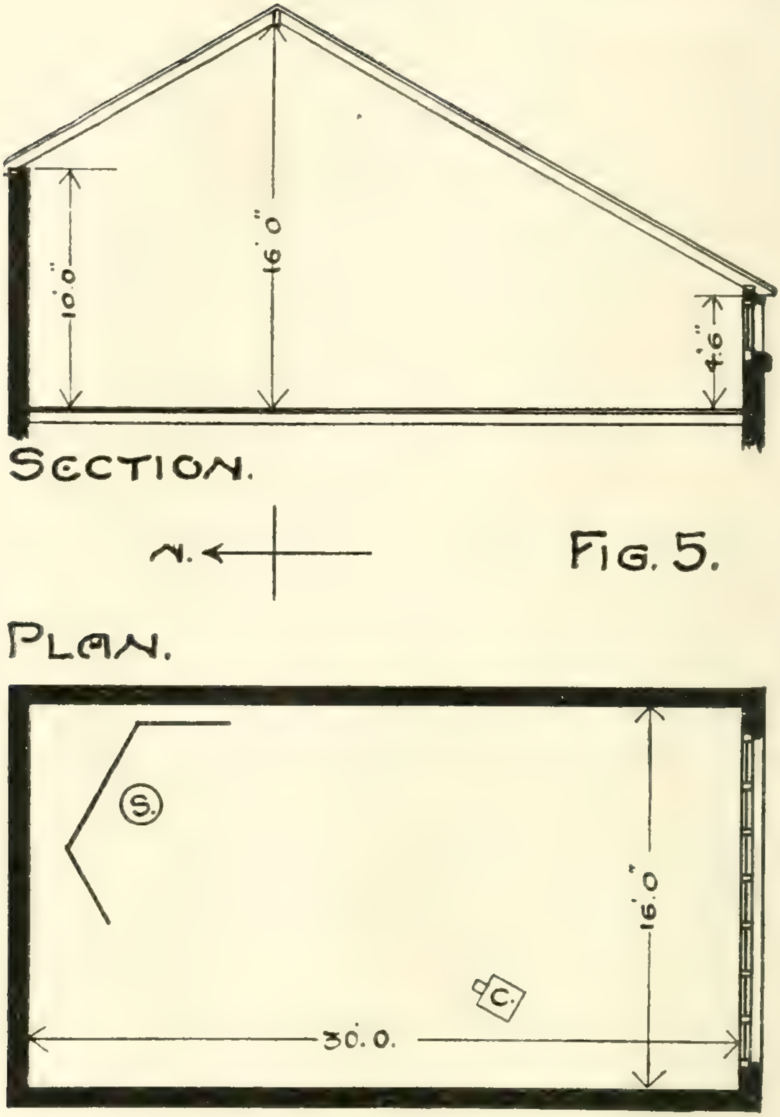


FIG. 5.

instead of his name on his visiting cards, it became necessary for photographers to locate themselves in fashionable and business localities, and all sorts of places had to be used as and adapted for photographic studios.

T. R. Williams' Studio. One of the best known of these was that of T. R. Williams (Fig. 5.) which was made by removing the slates from a roof in Regent

Street, London, and replacing them with glass. This studio became a place of such fashionable and popular resort that if you look over almost any old English family *carte-de-visite* album of sixty or seventy years ago and find some especially good specimens of work, you are nearly sure to find the name of Williams on the back. His studio, as shown in plan and section in the diagram, was about 30 by 16 feet, the glazing of the roof facing nearly due south. This sunny aspect was dealt with by three sets of blinds, one of dark blue calico, the second of white calico, and the third of white jaconet muslin. The position of the studio could hardly have been more awkward, and with the complication of the three sets of blinds must have been very troublesome to manage; yet, under these conditions, was produced some of the best photographic work of that time, with a delicacy and modeling which were the envy of competitors and the admiration of his clients. In those days it was fashionable for everyone to carry his or her picture for exchange with friends, as is indicated by the verse which is often found in the old albums just referred to, and which runs,

"This is my Album, yet learn ere you look,
That all are expected to add to my book.
You are welcome to quiz it, but the penalty is,
That you add your own portrait for others to quiz!"

The success of Williams in his difficult environment is, of course, another instance of the fact that it is the man that matters more than the conditions under which he works; which may be of some comfort to many photographers who may not have all the accommodation they may desire or consider necessary.

But this is a digression, and to return to Williams and his studio we may note that his general method and direction of work, as shown on the diagram, was diagonally across the apartment, and that he employed a background, with hinged side wings which could be either used to cut off light or reflect it as required.

His success led to many imitations of his place and his methods, and to many attempts to work in still more unsuitable places, some succeeding fairly well in

the hands of competent men, but others being lamentable failures until many costly experiments were "scrapped" and swept away by the gradual evolution of the oblong apartment with its side and top light and ridge or lean-to roof, much as we know it today.

Valentine Blanchard's Studio. We may, perhaps, fitly close what I may call the historical part of the subject, by reference to a rather more modern studio than the last named, namely that of the late Valentine Blanchard, which I have also chosen for illustration because it affords us another example of how genius not only triumphs over difficulties but also sometimes turns them into positive advantages. Having, for the reason of their good location from a business point of view, chosen premises in which the only available light for the studio came from the south and east, Mr. Blanchard put up a place for working mainly by the southern illumination, and his plan, as shown in Fig. 6 may yet be of interest to photographers faced with a similar predicament. The solid black lines in the diagram show the opaque portions of the walls and roof, and the shaded parts, where the glass was covered with papier mineral. In front of the clear portion of the glass, Mr. Blanchard placed, as will be seen, a translucent screen to intercept the direct rays of the sun when necessary. The ordinary positions of the camera and sitter were as shown on the plan, but could, of course, be reversed to light the other side of the face when desired. The east window was generally kept curtained and had little or nothing to do with the actual lighting of a single sitter, though occasionally used to equalize the lighting on groups.

In Mr. Blanchard's description of the place he said "The sitter cannot see the side of the screen on which the sun's rays fall, so that there is no sunlight to dazzle the eyes, and for ordinary work one screen is sufficient. As the sun travels westward the screen can be drawn to the east to give more light if necessary. In fact, when working with the sitter either at the east or west the screen can be moved about according to the time of day and yet give the sitter all the light required."

Writing again, in the winter of 1877, Mr. Blanchard

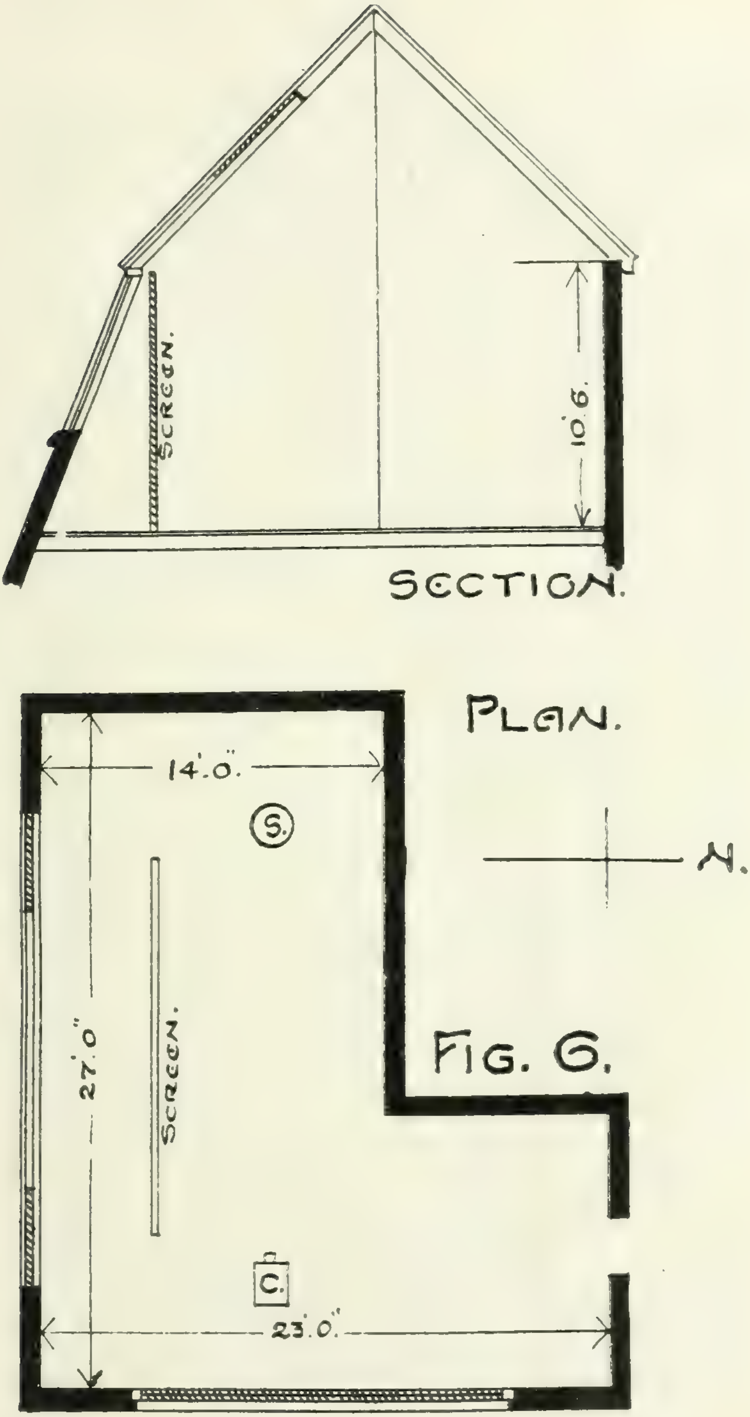


FIG. 6.

further said "A year's experience, embracing as it does all the variations between the oblique light of winter and the almost vertical light of midsummer, only confirms the high opinion before expressed. The gain in rapidity of the south over the north light is at once apparent to anyone who has tried both. During the past gloomy months I have made pictures that would have been absolutely impossible with a north light. I find that, now that I have it well under control, those beautiful luminous yet delicate effects frequently seen in photographs from Italy and America, and due to the penetrating power of pure intense light, are readily obtained with this illumination."

The Location. From the above it will have been seen that the location dictated by business considerations may often govern the actual design of the studio, and that if the ideal structure cannot be obtained, very often an extremely good substitute may be devised. Therefore, before considering the ideal modern studio itself, we may next give some thought to the consideration of where it should or may be placed.

It should be obvious that a photographer capable of producing work of a quality appealing to a cultured and wealthy clientele, must locate himself in the vicinity of the residences of such classes or in the first-class shopping streets which they are already in the habit of visiting. Similarly, one whose work is of a more purely commercial character must be in the way of customers likely to be attracted by the work he produces. Therefore, the first consideration in the choice of location is the suitability of the neighborhood to the class of work the photographer can do. This is the rule generally followed here and abroad. In New York, for instance, a Fifth Avenue location is most favored, although there are several prominent studios on the side streets off the Avenue. In other American cities, especially in the smaller cities, the fashionable studios are sometimes found in the best residential sections, as, for example, the Strauss Studio, of St. Louis, and the Clark Studio, of Detroit. This is also very much the rule in London, the two principal streets for photographers who cater for the upper classes being Baker Street, in which are

situated the studios of Elliot and Fry, Ellis and Walery, Malcolm Arbuthnot, Thomas Fall, etc.; and Bond Street, in which we find Messrs. Speaight, Lafayette, Swaine, and others, all in close proximity to the more expensive and high-class shops which do their share in attracting the class of customers catered for by those photographers.

The Small City. But the photographer is, of course, wanted everywhere, and the same conditions which govern the choice of locality in the great cities also operate in the smaller centers of population. The great thing is to get into a position that is either residentially frequented or easily reached by the class of customer catered for, and in this connection, when exploring or considering a neighborhood not well known to him, the photographer may note that the class of other businesses already established in it is a good index to its possibilities.

Of course, in the great cities and larger towns, more capital is necessary in order to make an effective start, and there is more scope for the extension of both business and fame among a large population than in smaller communities. But there are also often other considerations, such as the residence of friends or relatives who may be of assistance in forming a connection, or the presence of a large school or university, a summer colony or similar factors which may influence the choice.

Nowadays, also, suburban districts are often not without good possibilities, and many people will prefer to be photographed nearer home, when good work can be obtained, than to go a journey for something possibly not a great deal better.

The Best Side of the Street. Following the choice of a neighborhood or district comes that of the best place in the chosen street, and here it may be remarked that one side of any given street is nearly always better for business purposes than the other. It is not altogether easy to say why this should be so, but the fact is often easily recognizable. In the example given, of Fifth Avenue, New York City, both sides of the street are equally favored in this detail. In other cities there is seen a local preference, but generally in streets run-

ning east and west, it is the north side that is the best, and in streets running north and south, the east side, possibly because the sidewalks are warmest and sunniest on those sides during the shopping hours of the day. Anyway this is a point worth taking into consideration, as also what businesses the adjoining premises are devoted to. As ladies form the majority of most photographers' clientele, it is well to have for neighbors such shops as deal in jewelry, ladies' wear, artistic furnishings, and others which will help in attracting their presence.

Business Premises. The next important consideration is the choice of premises themselves, both as regards the studio, reception, and other accommodation required, such as workrooms, and the like. Of the latter it is not the province of this present brochure to discuss in detail, so they may be dismissed with the single comment that the working accommodation should have abundant light and be as commodious and convenient as possible. Both the reception rooms and studio must, however, be considered here, as well as the external appearance of the premises generally. This latter is of considerable importance, for no matter what the class of business may be it will be all the more successful if carried on in an attractive and more or less artistic environment, and while pretentiousness is always to be avoided on the one hand, so also are sordidness and unkemptness on the other.

Outside Display. For all classes of business, provision for an outside showcase or display is almost always necessary, although many well-known photographers have worked successfully in private houses with little or no outside display of their work; the larger firms, however, almost invariably have some such means of attracting attention and custom by the exhibition of their work. The shop window or display case need not, however, be of any great size; indeed, a small display of a photographer's very best work is often more effective than a larger and more miscellaneous collection in which the inclusion of inferior work will only bore the spectator and lower the average of the whole. In town or city premises, what would in ordinary businesses be the

shop becomes in most cases the reception room, and the window is usually easily adaptable to the display of specimens of photographic work. Its decoration should be of a dignified and artistic character, hardwood construction being used if a new window is to be put in, or painting in black, white, brown, or cream if old work has to be rendered suitable. The glare of brass or other metal work, loud colors, and the like, should be avoided as interfering with the sober monochromatic effect of photographic work. The window interior is generally best treated with fabrics and draperies of quiet self color, and sets may be made to suit different kinds of displays at different times; such as greys or creams for platinum or bromide, browns or creams for sepia-toned prints, or dull reds or greens for work in color. It is also a rule that the smaller the work the finer should be the texture of the background against which it is to be seen; so that miniatures may be placed against silks and velvets, medium-sized work against linens and hollands, and enlargements against canvasses and the like.

The Reception Room or shop should, of course, be well lighted, and if the shop window is a high one it is better to leave its upper part unobstructed to assist this than to fill the space with specimens, which latter can only be seen from without by undue straining of the head and neck of the spectator. The decoration of the reception room should be quiet and simple, like that of the display window, and if any particular "period" be chosen it should be one which complies with that condition. What is known as the "Adams" style is very suitable as the ornament of its plaster and woodwork is sparing and delicate and so does little to detract from the work shown near it. The reception room, if it be not a shop, is still best situated on the ground floor, if possible, in order that possible patrons who may wish to make enquiries may do so with the minimum of trouble and exertion.

The Ground-Floor Studio. For the same reason, the ground-floor studio is also desirable, but except in suburban areas or country towns this is very often not possible, although now that artificial lighting is being

adopted more largely we may hereafter see ground or street-floor studios even in the largest cities. In the case of ground space being available for a daylight studio, the site chosen should, if possible, admit of the studio receiving its lighting from the north without obstruction from near buildings or trees, in which case something very nearly like the ideal form may be obtainable. A small near obstruction may, however, be quite as detrimental as a larger but more distant one, so when noting these points it is well to see that nothing objectionable subtends more than an angle of 45 degrees above the level of the lowest part of the studio light. The color of fairly near buildings may be also a factor for consideration, as a whitewashed wall will be naturally less harmful than a red brick one in the same position, especially if either be at any time directly illuminated by the sun, with a consequent reflection of its color into the studio. The white reflected light can, of course, be easily modified, but the red brick building would certainly lead to increased exposure being necessary as well as rendering judgment of the modeling being obtained very difficult. In a second- or third-floor studio, or the usual top floor, the chance of obstruction naturally becomes less and less, especially in town sites, and often a little raising of the studio level may altogether avoid it, and the improved lighting may often be set against the necessity for stairs or elevator when the studio is higher up.

To return, however, to the case in which we can erect a ground-floor studio without obstruction, we may next consider the various forms which it may take, most of which only need certain modifications when used at higher elevations. First comes the question of size, and here, as in many other things, the *via media* is the best, a very large studio being often quite as inconvenient in use as a very small one. If plenty of space is available it is generally better to plan for a room adjoining the studio, and connected with it, as a storage for furniture and accessories not in immediate use, thus leaving the studio floor space clear. In some cases, a scene dock, running at right angles to the length of the studio, may be provided at one or both ends and

provide for the getting out of the way of backgrounds while having them handy for use when wanted.

Size. With regard to the question of size, it may be said that for ordinary portrait work the maximum size of a convenient studio is about 36 by 18 feet, and the minimum about 18 by 10 feet, in both of which cases it will be seen that the proportion of length to width is about 2 to 1, which proportion may be usefully maintained in intermediate sizes. A very large studio is more difficult and expensive to heat, and costs more to equip with shades or blinds, furnish, maintain and repair than a small one, while the latter affords less space for the movement of backgrounds, apparatus, and sitters, and consequently has less facilities for variation of effect and lighting. With regard to the latter it may be also noted that in a very small studio the sitter may be generally too near to the source of light, i. e., the portion of clear glass in use, and much of the modeling be thereby eaten out by overlighting. About 7 to 8 feet is a good average distance for ordinary work. The longer the studio the longer, of course, can be the foci of the lenses used in it, with, up to a certain point, very considerable gain in the drawing and perspective of the picture produced. This, however, is always accompanied by the fact that there is then always more illuminated air between the lens and the sitter which, especially when, as in large cities, the atmosphere is laden with dust or fog, will produce a foggy and flattening effect on the negative, and so here again the medium size will be found to be the best, and 30 feet may be regarded as a good average. In considering the interrelation of the lengths of studios with the foci of the lenses to be used therein, it is also necessary to take into account the sizes of the plates to be covered, as, of course, good covering power is always required in conjunction with focal length sufficient to give good drawing, yet not long enough to place too much atmosphere between the lens and the sitter. The following table will be of service in this connection.

Approximate focal lengths of lenses suitable for sizes of pictures given below:

Length of Studio in feet	3¼ x 4¼ full length	3¼ x 4¼ half length and 5 x 7 full length	3¼ x 4¼ head and 5 x 7 half length	5 x 7 head and 8 x 10 full length	8 x 10 half length and 10 x 12 full length	8 x 10 head and 10 x 12 half length
12	4	6½	8½			
14	4½	7½	9			
16	5	8½	10			
18	6	9	10½			19
20	6½	10	11	12	18	20
22	7	11	12	14	22	23
24	8	12	14	16	24	24½
26	8½	13	15	17	25	25½
28	9	13½	16	18	26	26½
30	10	14	17	19	27	27½

Cross-Section. The site, aspect, and length of the studio having been decided upon, the next question is that of the form of the cross-section, and here, in modern practice, we find generally one of the forms known as the lean-to, the ridge, the ridge and slant, or the single slant, and of five of these I have drawn a set of diagrams (Figs. 7, 8, 10, 11, and 13), all to the same scale, for purposes of comparison, and each shown with the width for which it is most suitable. The thick, solid lines show the opaque parts of the roofs and walls, and the thin solid lines the glazed portions of each, while the squares within each represent the ordinary 8-feet square background. The arrows descending from the left show how the sun in northern latitudes would fall when it is at its highest altitude of 62 degrees at midday in midsummer, and the dotted lines from the right the angle with the horizon within which obstructions on the north side would be harmless.

In Fig. 7 the studio is shown in two widths of 10 and 15 feet with two different inclinations of the pitch of the roof, and how portions of the latter might be made flat, not only to save expense but also to provide accommodation overhead if required. This form of studio, as

Fig. 8.

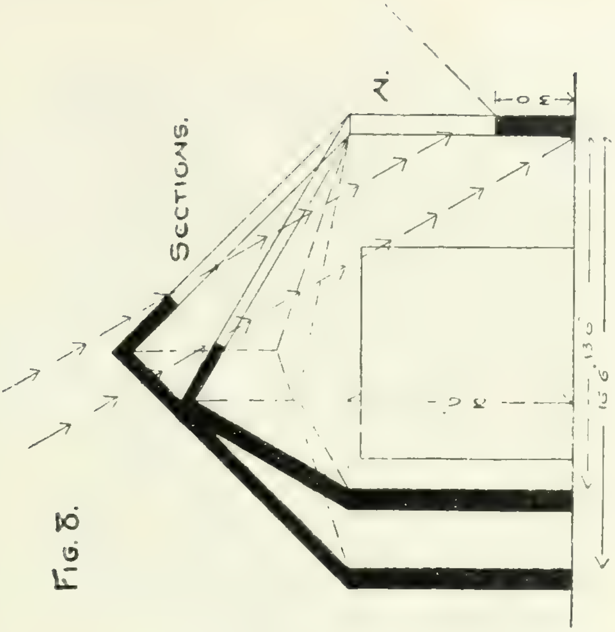
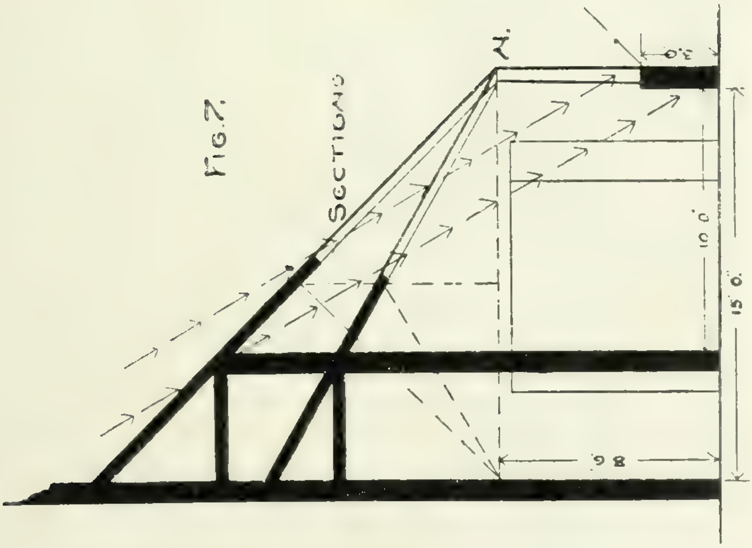


Fig. 7.



well as being the most suitable for a narrow site or room, is also indicated when there is already in existence a wall on the south side against which it can be built, more especially if the said wall is high enough to afford protection from the sun's rays from that quarter, as can be easily tested by setting up the angle of 62 degrees on any site. The narrower the studio the flatter may be the pitch of the roof, in order that top light may be more easily obtainable when required. In this connection it may be said that the angle of the roof does not, in any case, as is sometimes supposed, have anything to do with the angle at which the light falls on the sitter, the latter being determined solely by the position of the light area, or portion of clear glass in use, with regard to the position of the sitter in the studio. The light certainly does not enter in a path at right angles to the plane of the glass, as many photographers appear to think, but a line drawn from the center of the light area to the head of the sitter may be taken to give its general angle and direction.

Fig. 8. The next form of studio (Fig. 8) is perhaps the one most generally in use, being best adapted to studios of medium width and of detached construction, and its form being quite familiar to the ordinary builder. The two examples shown are of 13 feet 6 inches and 16 feet 6 inches in width, the unsymmetrical form having the roof pitch at 60 degrees on one side and 30 degrees on the other, this form being the most suitable for the narrower width, and the symmetrical form having both sides at an angle of 45 degrees, and being best for the wider room. The latter form, of course, lends itself best to schemes of internal decoration, a point we shall consider later on. It will be noticed in all these diagrams that the wider the studio the higher may be the solid portion of wall on the lighted side; also that in the wider forms there is, of course, more play for the movement of backgrounds so that the latter may not be too close to the light. In both the lean-to and ridge forms of studio the proportions of the side and top lights may be greatly varied to suit different positions. The studio occupied by the writer, shown in Fig. 9, had large and flat top lights and very low side ones, the

latter being seldom used except for some so-called "Rembrandt" and similar effects.

Fig. 6. The ridge and slant form of skylight, which is seen in Fig. 6, is also suitable for studios of medium width, but does not, to my mind, embody much that is of advantage over the vertical light, but it was used extensively in the studios of thirty years ago, and notably by Reutlinger of Paris, in whose studio the lower portion of the side light and the upper portion of the top light were glazed with slightly stained glass, so as to modify the light coming from those portions and concentrate the stronger light upon the heads and torsos of sitters in a standing or seated position. In all these forms of studio, the chief defect is that for constructional reasons it is often necessary to make the wall-plate, or beam at the junction of the top and side lights, somewhat large and heavy, with the result, when both portions are being used at once, of cutting the high light in the eye of the sitter in two, and so necessitating the use of the knife on the negative, or that of the spotting brush on every print so as to avoid an unpleasant effect. Many efforts to get over this have been made from time to time, principally by the use of metal sash bars of more or less curvature, as in the studio of Strauss, of St. Louis, or even by making the whole roof semi-circular, as in that of Lafayette, of Dublin, both of which forms are shown in Fig. 10.

Figs. 11 and 12. The drawbacks of these forms of construction are that bent glass is expensive in the first instance, and often difficult to replace without delay when accidentally broken, and that spring roller blinds cannot be used with them as with the more ordinary forms of construction. With the latter it is also easier to use one of the many forms of patent glazing which have replaced the old sash-bar and putty, and in which there is none of the latter perishable substance to decay, while the cappings of the rolled steel or other bars can usually be easily raised to replace broken glass with very little trouble or loss of time. These glazing systems are also specially suitable for use in the "single-slant" form of studio, as shown in Fig. 11. Here the pitch of the roof is 60 degrees and so not only keeps out

Fig. 10.

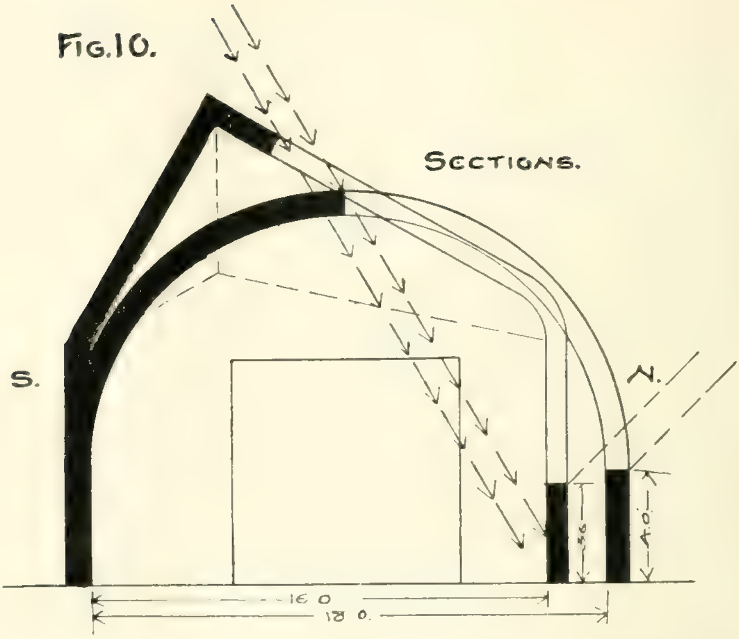
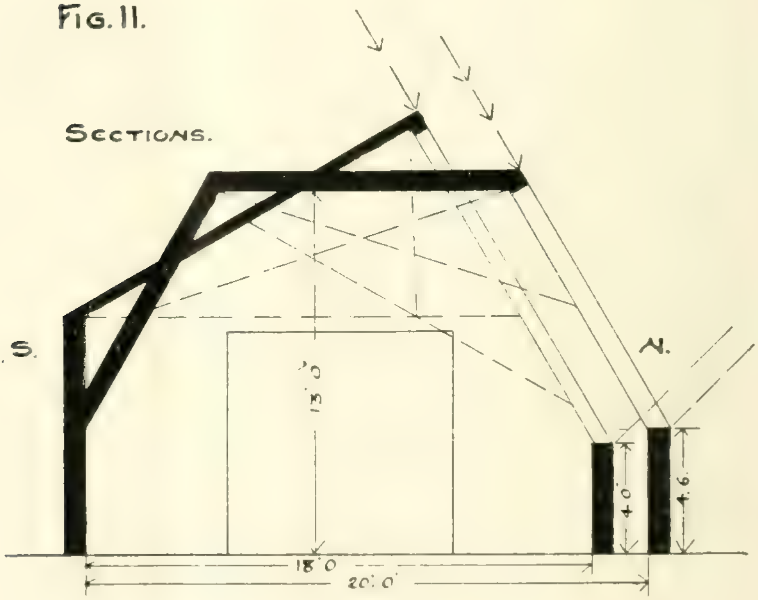


Fig. 11.



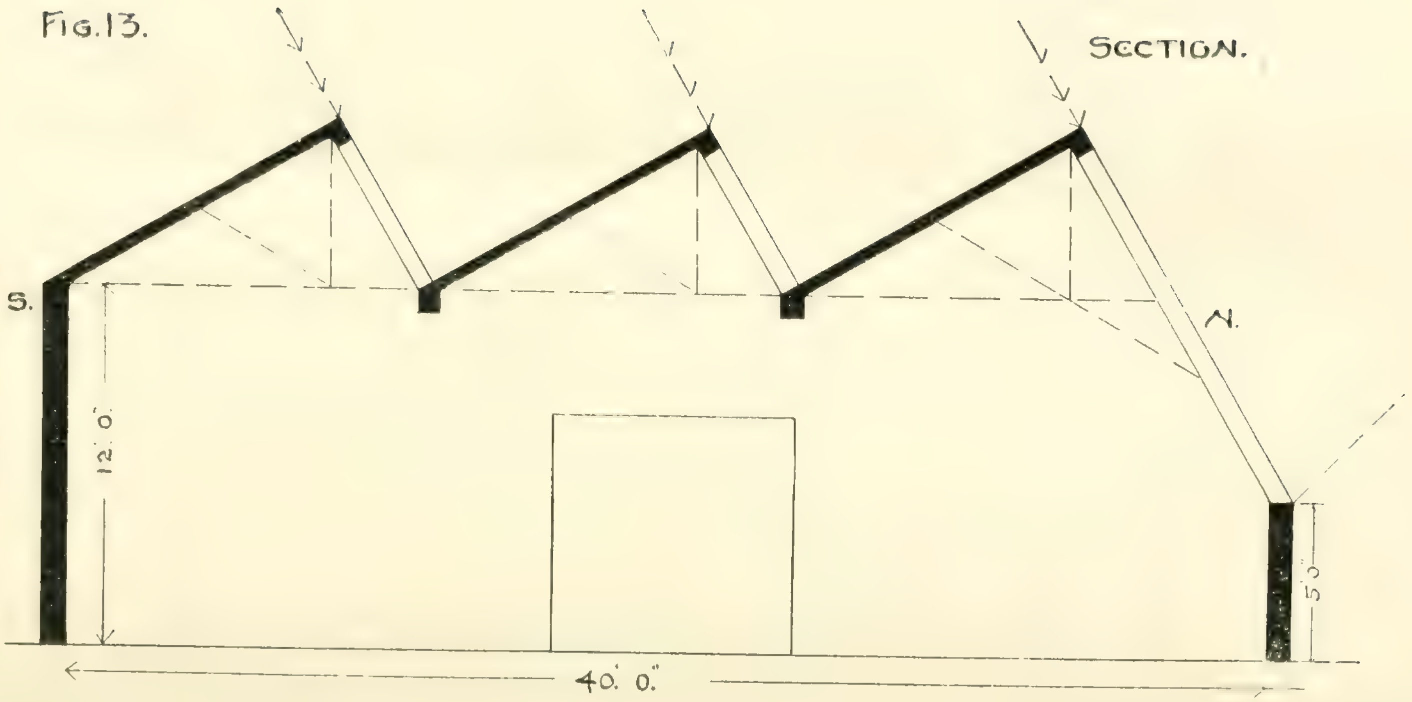
the sun but also very easily throws off water and snow, while the glass is almost as easy to clean, either from inside or outside, as the ordinary vertical window; and in cases in which there is no near obstruction of the light and the studio can be made of a decent width, say not less than 16 feet, it is, I think, quite the best, most efficient, and weatherproof form of construction for a daylight studio. Two well-known American examples of this form are the studios of J. L. Stein, of Milwaukee, and the late F. W. Guerin, St. Louis, while one of my own design for the Irish Lace Depôt in Dublin is seen in Fig. 12. This studio, being intended mainly for groups and full-length figures dressed in the complete lace costumes largely dealt in by the firm, has the side light, as will be seen, almost down to the ground, and a good deal lower than would be necessary in an ordinary single slant portrait studio, in which the bottom of the glass may be quite 3 feet from the ground in a studio of fair width.

With a double set of opaque blinds or shades, on spring rollers, one to draw up from the bottom and one to pull down from the top of the light area, and a set of transparent ones running horizontally on wires beneath them, any effect of lighting can be secured in this form of studio, while for copying, by working across the studio, the flattest possible lighting can be obtained. When made in the symmetrical form, this section is also quite amenable to very satisfactory schemes of decoration, even to the extent of decorative lunette paintings on the upper part of the end walls between the roof-lines at both ends.

Fig. 13. In addition to these more or less "standard" forms of studio, various others have from time to time been used of late years, such as those with double roofs somewhat on the so-called "saw-tooth" or "north-light factory" system, as shown in Fig. 13. This form is, however, only suitable for very large studios, intended mainly for very large groups or commercial work. There is also what H. P. Robinson called the probable "studio of the future," which was to be a large square apartment with a vertical side light some 15 or 16 feet high. The New York studio of W. M. Hollinger has such a vertical

FIG. 13.

SECTION.



light, supplemented by a tunnel skylight over the center of the room.

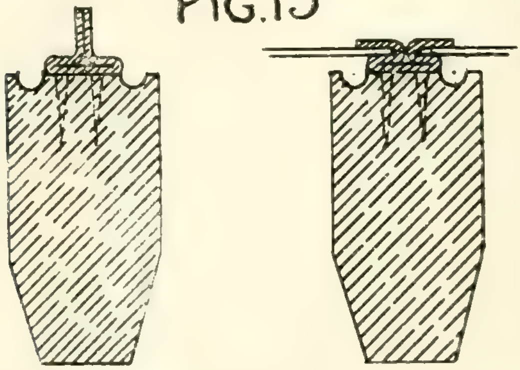
Ties and Principals. In nearly all of the beforementioned forms of construction, save where the studio building is confined by buildings on either side, some tie-rods or roof principals will be found necessary to counteract the outward thrust of the roof upon the walls, and in the diagrams these are shown in dotted lines. In small and narrow studios the former, made of ¾- or 1-inch round iron rods will be generally found sufficient, but in larger and wider structures, properly designed and framed steel principals will be necessary, and the aid of a properly qualified architect or constructional engineer, who will calculate the weights and stresses to be dealt with, should be called in. Such ties and principals should always be arranged at such a height from the floor that the ordinary 8-feet backgrounds stretched on frames, will pass easily beneath them.

Glazing. The form of studio having been chosen to suit the special set of conditions present in the environment, or to fulfil the working requirements of the owner, the next point for consideration is that of the glazing. With several exceptions it is not necessary for the lighting area to extend the whole length of the studio, and a solid portion at each end is usually desirable, under which the background and sitter can be kept out of the toplight when necessary.

In a 30-foot studio, 15 feet run of glass, with a 5-foot space of solid roof and sides at each end, is a full allowance. The exceptions are the case of a very short studio, when to get enough front light upon the sitter the lighting area sometimes needs to extend right to the camera end; and the case of a studio in which much of the so-called "sketch" or white background work is intended to be done, when it is necessary to illuminate the ground as much as possible by light falling upon it behind the sitter, independently of the other light area by which the modeling is obtained. In any case, plenty of light should be obtainable in any studio, as that not required can, of course, be blinded out at any time. In short, the reason for having plenty of light when desired

is the same that I generally give for the constant use of backed plates, namely: "You don't want it often, but when you do want it you want it badly!" With regard to the sash-bars and methods of glazing, one of the modern methods of puttyless work with patent sash-bars should be adopted, as being generally not only weather-proof, but also providing means of carrying off condensation and admitting of the easy removal and replacement of broken glass. The simplest possible

SECTIONS.
FIG. 15



form of these is Grover's "Simplex" system, two sketches of which are given in Fig. 15, one showing the lead slips which hold the glass, as placed on the wooden sash-bar, and the other how they are turned down after the glass is in position. This form of glazing is cheap enough for the smallest studio, and is much preferable to putty of any kind. Many more elaborate forms, some with steel sash-bars, and some with zinc strips and cappings for the glass, are in use here and abroad, as to which architects and builders are well informed.

Choice of Glass. To come to the glass itself, this should, of course, be of the clearest and whitest description available, the thickness depending on the size of the sheets used. These should always be as large as possible, in order to avoid the overlappings which form traps for dust and dirt, which are carried into them by capillary attraction when the roofs are wet. Clear, ribbed or cast plate glass is to be recommended as being

better and stronger, as well as obtainable in larger sizes, than ordinary window glass. The clear can be used in most situations, but where a studio is overlooked from top or sides, either the ribbed or cast varieties will overcome the difficulty with but very little, if any, loss of light. Ground glass should, however, never be used as its surface is a great holder of dirt and the stoppage of light by it quite appreciable. Strongly ribbed or rolled glass will often, however, diffuse direct sunlight in quite a satisfactory manner, and may consequently be occasionally used on portions of a studio roof that may at times get direct rays of it. At one time there was apparently an idea that a bluish tint of glass would render ordinary daylight more actinic, but modern spectroscopic research has quite exploded it. I have also seen a very pale yellow tint recommended for use with panchromatic plates without a filter, but not having personally tried the experiment cannot endorse the suggestion.

Artificial Light Studios. Thus far we have been assuming that the studios under discussion have been required for daylight work only, but today, with the advantages of artificial light so well understood and so many lighting systems available, studios for working by artificial light alone, usually electric light, or in conjunction with daylight, are very rapidly becoming more and more numerous. A studio using an electric lighting system only has the advantage that it may be located on the street or any other floor of a building, e. g., the studio of Pirie MacDonald occupies an upper floor in a New York business building. What we have already said about length and width here also holds good, while in the matter of height it is only necessary that the source of light should be sufficiently above the head of a standing figure to give any modeling required by the ordinary rules and principles of lighting. For this purpose almost any height above 10 or 11 feet will do, but something, of course, depends on the shape and bulk of the lighting apparatus used.

Lighting Systems. The varieties of these may be classed as open arcs, in which the light is produced by a spark between one or more pairs of carbons; enclosed

or flame arcs, in which the light is enclosed in glass globes; or incandescent lamps, with carbon or metallic filaments heated to whiteness by their resistance to the current; and, lastly, the Cooper-Hewitt light such as, I believe, Mr. MacDonald uses exclusively. The open arcs are usually fitted in parabolic or umbrella-shaped reflectors, a smaller concave shield preventing the direct rays reaching the sitter who is illuminated solely by the light from the interior of the large umbrella or reflector. The latter is usually mounted on a movable stand, and in this form the apparatus is specially suitable for normally daylight studios, in which electric lighting is only used at night or in bad weather, as it can be easily moved out of the way, when not required. Owing, however, to the size of the umbrella or reflector and its height above the actual source of light, it is not suitable for low studios in any case. This system is not, as far as I know, employed in America. Most of the flame arc lamps also have a considerable bulk above the containing globe. I have seen three such lamps, bunched behind a diffusing screen or cabinet, successfully used in a studio devoted almost entirely to child portraiture.

The most favored form of electric lighting is the use of powerful incandescent metal filament lamps of the Mazda type. In these the body or stem of the lamp is not long, so that, in a fixed installation, they may be hung from a fairly high ceiling, preferably on an L-shaped plan, with the long arm to the side and the short arm to the front of the sitter. With a set of these, from five to seven in number, each on a separate switch, many varieties of lighting may be easily obtained and with good candle-power, very short exposures be given. In most studios, however, portable or movable systems are employed, the lights being grouped in sets on stands for area lighting, or used singly, with powerful reflectors, for "spot" or "back" lighting. The Prosch system is an example.

The Cooper-Hewitt mercury vapor lamp, already referred to, gives an extremely actinic but visually unpleasant light, the lights appearing green and the shadows red. This is largely used in America by such eminent photographers as Pirie MacDonald, Charles

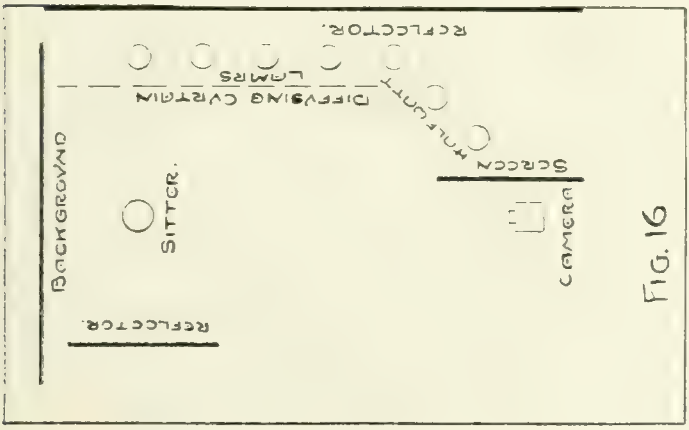


FIG. 16

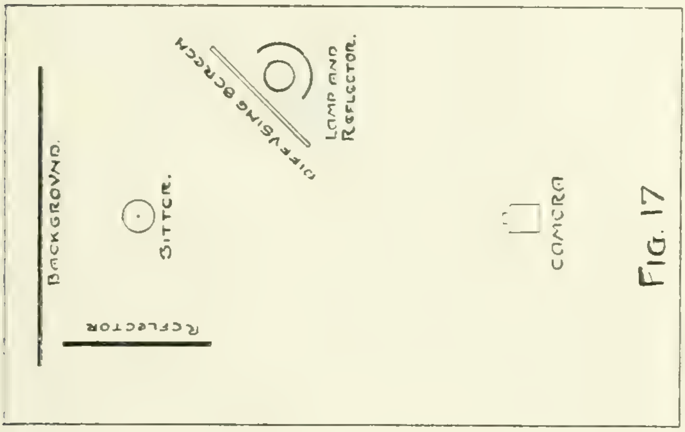


FIG. 17

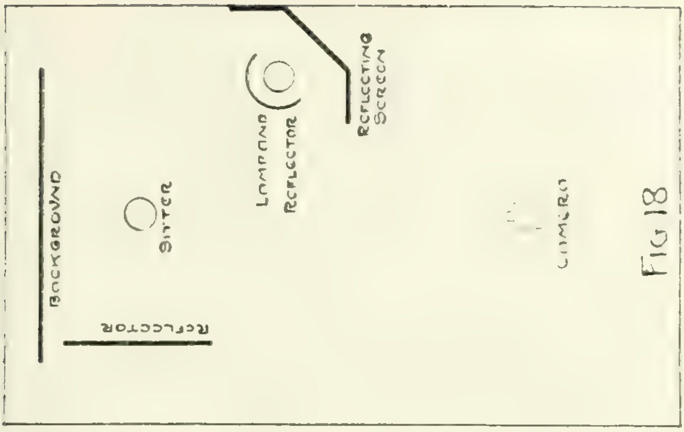


FIG 18

H. Davis, and many motion-picture studios, as well as by a fair number of studios in England. Most electric lighting systems require, of course, the use of both diffusers and reflecting screens, and Figs. 16, 17 and 18 give a general idea of the arrangement of them and of electric studios generally for direct and indirect lighting respectively.

Heating. Next to the lighting comes the question of heating the studio, and here there is no doubt that some system of high or low pressure hot water or steam, used with radiators, is the best and most effective, as the radiators themselves can be placed in any convenient position, the best perhaps being under the glazing on the lighted side where they will also assist in the prevention of condensation on the glass. These systems, of course, require separate furnaces and boilers, accommodation for which is best found in the basement if the studio is on the ground-level. This form of studio heating is generally provided in American business buildings.

Next to a circulating system comes heating by gas, many forms of which are available, from a regular gas stove to an ordinary grate, fitted with Bunsen burner and loose asbestos lumps. Lastly comes heating by coal, either in closed anthracite stoves or in the less convenient and less cleanly, but certainly more pleasing and cheerful, open coal-fires, of which we are so fond in England, but which I expect many of our American cousins would consider wasteful and troublesome.

Ventilation. Closely connected with the question of heating is that of ventilation, which includes not only the admission of fresh but also the extraction of foul air from the studio. The latter can be effected by the use of electrically driven exhaust fans, or more simply and naturally by the Boyle system of cowls which, though without moving parts, continue to exhaust the air as long as there is any movement in the atmosphere outside. They are well supplemented by the Boyle inlet panels, a form of the original Tobin tube which are very well placed under the radiators or gas stoves, when the air is warmed as it comes in, and by various simple devices also filtered when necessary. Mention has

already been made of the necessity, especially when long-focus lenses are being used, of keeping the air of the studio clean and pure, and any system of ventilation should take this into account.

Decoration. Having thus discussed some of the principal points of the construction of the studio, we may now consider its decoration and equipment. It may be first said that the less it is made like a workshop and the more like an ordinary home room the better will be the visual and psychological effect it will have upon the sitter, and the more at home he or she will feel, and consequently look, in it. Its general aspect may well be bare rather than overfurnished. No work of any kind, except the actual operating, should be carried on in it, and it should hardly be necessary to add that it should always be scrupulously clean and with everything in perfect working order. Nothing is more disconcerting to both sitter and operator than for the former to see the latter struggling with a badly working camera or refractory blinds, or the latter to see the former becoming bored or impatient while he is completing his arrangements for the actual taking of the picture. The elaboration of the decoration of a studio will, of course, depend upon the social status of the clients catered to or the personal taste of the owner; but, as a general rule, whatever style may be adopted the general effect should be quiet and restful, and the scheme of color sufficiently light to give diffused reflected light on the shadow side of the sitter. This is especially the case in large studios in which the walls on the unlighted side are generally but poorly illuminated themselves.

Color Schemes. For wall surfaces generally, soft warm greys or buffs will be found often suitable, but the green that is sometimes recommended is a mistake on account of its light-absorbing character, and more than once I have had to recommend its removal in order to improve the lighting qualities and reduce the exposure in poorly lighted studios. Both ends of the studio should be decorated in such a manner that they may serve, when required, as fixed backgrounds for large groups, and to have one of them light and the other dark

is also an advantage. An instance of this is the studio of Mr. Walter Scott, of Bradford, for which I recommended Tudor oak paneling at one end and Adams relief decoration in white at the other, both of which have proved very useful in the production of artistic pictures. Relief decoration of the Lincrusta and Anaglypta types is also very useful for this purpose, as well as for other parts of the walls and ceilings of studios, especially as they can be painted with flatted oil or distemper to any tint required. There are also many canvas and other fabric wall-coverings which may be used plain, or paneled out by simple moldings, and these are often very useful for covering old or unsightly interiors. When used over old matchboarding the canvas should not be glued or pasted down to the wall, but strained and nailed at the edges only of the material, otherwise the joints of the boarding will be apt to show as the latter swells and shrinks with variations of heat and moisture. For the same reason, also, ordinary wallpaper should not be used over an old or new boarded surface. When flat strips or moldings are used to cover the joints or to panel out, the contrast of color between them and the panels should not be great, or the restfulness of the background will be destroyed and very awkward lines be often produced in the pictures taken against it. When oak or other hardwood paneling is too expensive, a quite effective substitute may be produced in white or soft wood stained to any required tint with any wood stain and wax polished. Figure 19 shows an original design of my own for work of this kind, the finished product appearing in Fig. 12.

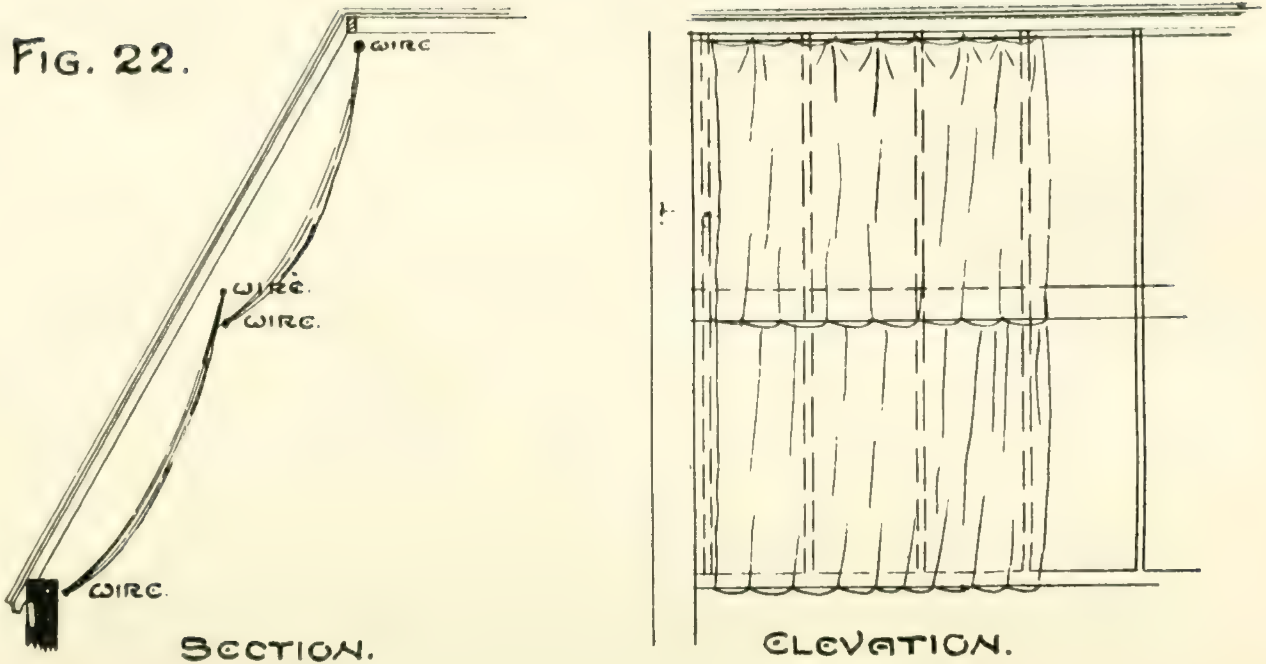
Adapting Old Material. In considering the decoration of an already existing studio, regard should, of course, be had to any special features of a permanent or unalterable nature. Very often the photographer himself may possess some fittings which may be worked into the general scheme. Both these conditions were operative when I came to decorate, for my own use, the studio which has already appeared in Fig. 9. In this the steel purlin carrying the rafters could not be altered or removed so it was cased in with moldings, as shown, to harmonize with the other new woodwork

in the pilasters, cornices, etc. The "Cosy Corner," (Fig. 20) was suggested by the presence of a flue for a gas stove in the corner of the studio, and the frieze and pediment of it were made from portions of a real "Adams" mantelpiece, taken from an old house in Hampshire, while the Lincrusta decoration within came from some old fixed backgrounds left by the former occupant on the premises. The walls of the studio were covered with a soft grey ingrain paper, with an appropriate frieze in dull pale tints, and the woodwork generally painted a warm ivory white.

Floors. From walls to floor is an easy transition, and for that of a studio nothing is, of course, better than solid parquet, affording, as it does, a firm, level surface for the movement of cameras, backgrounds, and the like, and, when well polished, a rich and good class appearance. The latter may, however, be nearly as well obtained by the cheaper and thinner parquet, of about three-eighths of an inch in thickness, which may be laid over old boarded floors to improve their appearance and wear resisting qualities. A good new floor may also be stained with any desirable stain, or even with a mixture of Brunswick black and turpentine to any desired tint, and then wax polished the same as hardwood or parquet floors. Varnish, or the so-called varnish stains, should, however, be avoided as they very easily chip, crack, and get marked and so become very quickly poor and shabby looking. A fairly good floor, in which the boards have not shrunk or the joints opened, may also be very satisfactorily covered with linoleum or cork carpet, the former of which will also take very well most of the wax polishes in general use. Carpets are not to be generally recommended for studio use as they soon show signs of wear in the most used spots, and, unless constantly gone over with a vacuum or other cleaner, harbor a good deal of dust and dirt. On linoleum and polished floors, however, a few rugs of various sizes are generally desirable, but these, like the linoleum itself, should be subdued in color and unobtrusive in pattern or they may prove very assertive in pictures in which they appear.

Shades or Blinds. To go on to those parts of the

FIG. 22.



SECTION.

ELEVATION.

studio equipment which are more particularly of photographic use, we may next consider the blinds of the roof and side lights. In any case, two sets of these, one opaque and one transparent, are needed. Personally, I prefer the former, which are, of course, used for the control of the direction of the light, to be fixed on spring rollers so as to pull up from the bottom of the light, and down from the top, and to have the transparent diffusing ones running festoon fashion on horizontal wires beneath them. See Fig. 22. Both sets of blinds may be fixed on the same set of horizontal wires, by the usual rings, there being sufficient of the opaque ones to cover nearly the whole length of glass when required, the transparent ones being placed in the center and being of sufficient width to cover the average light area used. No one blind, either top or side, whether on rollers or wires, should be more than about a yard wide, or sufficient accuracy in the direction of the light will be difficult to obtain. Roller blinds should be of a good holland; opaque festoon blinds or curtains in serge or casement cloth, and the transparent ones of good unfadable or sunfast art muslin. All pulleys, cords, and the like, should, of course, always be in good order and ready for immediate use.

Before leaving the subject of the blinds I may add that it is a useful operating tip to keep them nearly all closed and the studio consequently as dark as possible until the sitter has been posed, as then the pupil of the eye will be darker and fuller than as if it had been made to contract by entrance into a brilliantly lighted apartment.

Apparatus. Of the other purely photographic appliances of the studio it may be said that they should be of as good quality as the means of their user will allow, and should be as little in evidence as possible, and consist of nothing more than is really required for operating purposes. Old out-of-use cameras and out-of-date accessories should be strictly banished from any good studio as mere lumber, taking up space that is required for the constant movement of backgrounds, sitters, and cameras that are necessary if good and varied work is to be produced. It has been already said that no other

work than the actual operating should be done in the studio, and that not only because it is not good that sitters should see processes or methods or anything in an unfinished condition, but also because the presence of assistants is apt to produce that very self-consciousness which it is the aim of the good photographer to banish from the minds of his sitters.

Backgrounds. Amongst the most important of the equipments of the studio are the backgrounds, which, though movable in themselves, are not forming, like the blinds, fixtures of the apartment, yet bear very important relations to it, as also to the character and class of the work to be done in it. Although now happily banished from the studios of many photographers, I am sorry to say that the painted scenes, both interior and exterior, that were universally in evidence some years ago, still linger on in studios whose owners really ought to know better. The trouble with the elaborately painted ground is that in practice only about once in a thousand times will the lighting of the scenes correspond with that of the figure, while the lines of the composition nearly always come wrong, or in opposition to those of the posing of the sitter. This is true even of the best painted backgrounds, while in many of the cheaper class the artist seems to have had in his mind the commandment "Thou shalt not make to thyself the likeness of anything that is in the heaven above, the earth beneath, or the waters under the earth!" Many attempts to remedy this want of naturalness have been made, from projecting an actual photograph onto a large translucent screen behind the sitter, to the use of immense bromide enlargements as backgrounds, which is being practised by a well-known photographer in London today. But these expedients do not get rid of the difficulties of composition, pattern, and light and shade, presented by the painted scenes, and it will be generally found better to utilize the actual walls of the studio, if tastefully colored or decorated, for interior scenes, and for the few outdoor scenes required to confine oneself to simple cloudings or something in the way of the Reynolds or Gainsborough effects. These are very dark and vague, with perhaps just a bit of lighted

distance beyond, but all so soft and elusive as not to interfere with the composition or lighting of the figure itself. Plain graduated grounds are also very useful, especially when one desires to obtain atmosphere and relief by placing the lighted side of a head or figure against dark and the shadow side against a lighter tint, when the half tones of both figure and background will often blend together in the manner which is known to painters as "losing and finding," to the artistic advantage of the whole. When used for heads only, these graduated backgrounds may be mounted on frames with feet at both ends so that by reversing the top and bottom the gradation may go from dark to light towards either hand as desired. Nearly all backgrounds are also best mounted and stretched on frames, as they are then less liable to creases and injuries which would show in the photographs, and when mounted on castors are easy to move about as desired. They, however, take up a good deal of room, for which reason, when space will allow, it is a good idea to plan a sort of passage or scene dock, running at right angles to the length of the studio, either at one or both ends, into which they can be pushed when not in use. The average background is about 8 feet square so that about 9 feet height is needed for the scene dock, as also under any tie rods which may cross the studio itself. What are known as "continuous" backgrounds, or combined backgrounds and foregrounds, which are necessary for "sketch" work, may be conveniently mounted on rollers, and the latter on the movable stands, of which there are many more or less efficient patterns on the market. Curtains mounted on movable stands, or on stretched wires at convenient points, also often afford useful backgrounds, but care should be taken that they are either plain self-colored or that any pattern is very unobtrusive indeed or else they may easily detract from the figure in front of them.

Screens. As accessories to the background, which often need to be shaded or otherwise modified in effect, are screens of various kinds, which also play their part in the shading and lighting of the sitter. The latter, of course, is first done broadly by the use of the fixed blinds

already described, but in addition to them a circular transparent and a circular nearly opaque head-screen are both very useful adjuncts, as is also a bean- or kidney-shaped, nearly opaque one, all of which may be obtained mounted on light movable stands, with universal joints, so that they can be placed in any position with regard to the sitter and the light. A large rectangular frame, say about 7 feet high and 4 feet wide, with a spring roller blind of opaque material to pull up from the bottom and a translucent one to pull down from the top is also extremely useful in lighting and shading the sitter where required. Figure 23 shows an appliance of this nature, and Fig. 24 from an untouched photograph by the writer, shows a lighting obtained with this very useful accessory. So, also, sometimes is a reflecting screen (such as the Brieloff Reflectolite) made preferably with two or three leaves swinging at various angles useful in studios not well illuminated; but in lightly decorated ones it is not often required, except for lightening the shadows in the so-called "Rembrandt" effects. It is, in any case, rather "a good servant but a bad master," and needs using with much care to avoid cross and false lighting, especially in the eyes of the sitter.

The Head-Rest. Another doubtful accessory is the head-rest, about the use of which much diversity of opinion prevails, some photographers contending for the superiority of the short exposure and momentary expression, and others for the longer exposure and settlement of the features into repose, which calls for the use of the rest in most cases. Personally I incline to the latter method which was used in the case of Fig. 24, though perhaps the instance is hardly a fair one, as the sitter was a trained model. In America, apparently, the head-rest is rarely employed.

Furniture. Among the other equipment of the studio we must not omit the furniture, which should generally be much the same kind of thing that the class of sitters catered to would be likely to have in their own homes, and among which they will both look and feel most at home. Nothing is better than the reproductions from the antique which may now be obtained of all the best

periods, at very moderate prices, so well executed that they will give nearly as much artistic pleasure as the originals by Sheraton, Hepplewhite, or Chippendale himself. What is to be avoided, however, is the purely "photographic" furniture, i. e., that specially made for studio use, which is usually ugly, uncomfortable, and like nothing ever seen anywhere else. The many so-called "posing chairs" and other boxes of tricks which can be turned into various things one after the other, like that piece of furniture mentioned by the poet, which "contrived a double debt to pay, a bed by night, a chest of drawers by day," are also best left in the dealers' showrooms, from which they have not even yet disappeared.

Finally we come to the camera, and its stand and lens. Of the latter we have already spoken in its connection with the length of the studio, and a further discussion of lenses is not only rather beyond the scope of this already rather long dissertation, but would form, in itself, material for another monograph of nearly equal length. Of the camera, however, we may say that it should be of good size, preferably of the square bellows form, and certainly have both vertical and horizontal swings to the back, both of which will be found useful not only with single figures but also with groups of various sizes as well. If the camera is large, a repeating back for smaller sizes is desirable, and, in any case, a good number of plate holders should be provided to obviate the interruption of sittings for the purpose of changing plates as much as possible. The stand should be firm, yet easily moved, not likely to slip or shake when once adjusted, and be able to raise the camera to a good height or let it down very low indeed when required. The best studio stand I know is the American "Semi-centennial" which combines all the advantages thus specified.

To conclude—In photography, as in the Navy and Army, it is "the man behind the gun" that mostly matters, but if this little book should help any earnest marksman to improve his armament, its purpose will have been fulfilled.

Drinkwater Butt, F. R. P. S.

Notes and Comment

In Memoriam: Ludwig F. Hammer. From St. Louis, where he lived and worked for the past sixty years, comes the sad news of the death of Mr. L. F. Hammer, the veteran dry-plate manufacturer, at the ripe old age of 87 years.

Mr. Hammer came to America from Germany in the early fifties, spending the first few years in Canada and, later, settling down at St. Louis where, at the close of the Civil War, he opened a photographic studio. When the gelatine dry-plate first appeared, Mr. Hammer, like many professionals of his day, prepared the new plates in quantities as needed for his large practice. The fine quality of those first Hammer plates, however, eventually forced Mr. Hammer to abandon the studio and devote himself to the commercial manufacture of plates for his fellow professionals. The Hammer Dry Plate Company, of St. Louis, was thus founded and, at the time of his death, Mr. Hammer was still actively directing the ever-increasing business of the firm.

To meet and know Mr. Hammer was to love and revere him for the kindliness of his nature, his sunny disposition, and steadfast loyalty in friendship. In his life he exemplified the finest traditions of American citizenship and his passing will be noted with regret by all his friends here and overseas.

Stereoscopic Photography. An exchange notes the growing popularity of the stereoscopic picture among British amateurs, and rightly ascribes this to the introduction of the 40 x 107 mm. stereo cameras of French make. In these dainty instruments, which well exemplify the genius of the French in camera construction, the bulk and weight of the old-time, standard size stereo equipment is wholly eliminated, while in optical

equipment and efficiency they are well abreast of the times. One of the best of these 40 x 107 mm. cameras I have seen is the Ontoscope, an all-metal camera, fitted with a rising front, lever focusing adjustment of micrometric precision, F: 4.5 anastigmats and a shutter giving speeds up to 1–400th second. Those interested should get the descriptive leaflet of this new model, for which A. Madeline, 1416 Broadway, New York City, is the American agent.

The new European republics are evidently quite up-to-date in spelling. Thus I am advised of the organization of the "Eesti Foto Klub," with well equipped rooms at Kunington Nr. 1 Tallinn (Reval) Estonia, the members of which will be glad to receive catalogues of American photographic manufacturers.

THE 1921 KODAK CATALOGUE, now available at most dealers, makes a hit at first glance with the incomparable American Kodak Girl on its front cover and a Foreword announcing decidedly lower prices for Kodaks as compared with a year ago. This Foreword faces a charming self-portrait, made with the 1921 model of the 2C Autographic Kodak Junior which Dame Rumor says is to be "the camera of the year." It certainly is an attractive instrument in equipment, picture size 2⅞ x 4⅞ and price. The outstanding features of the catalogue, to my mind, are: The focusing model of the V. P. Autographic Kodak Special which, by a turn of the lens flange, gives a focusing range from 3 feet to infinity, and has a Kodak Anastigmat working at F:6.9—which means all sorts of possibilities; the No. 1 Autographic Kodak Special (to be ready in June); and a new exposure shutter, the Kodamatic, with speeds up to 1–200th second of tested accuracy and a sliding scale which shows, at a glance, the speed to use for each stop opening under different light conditions. All the Kodaks are now obtainable fitted with Kodak Anastigmats, American made lenses giving every anastigmat advantage at prices lower than is possible for imported

lenses. This marks a welcome advance in the American optical industry.

More Photography. The necessity of concerted effort to stimulate a wider use of the camera for pleasure and profit—to offset the distractions of the automobile, phonograph, wireless experimenting, etc.,—is engaging the serious attention of European photographic manufacturers and dealers. Thus British manufacturers are holding fairs, offering attractive money prizes in competitions for amateurs, and distributing free literature such as "The Gentle Art of Photography" in immense quantities. In Germany, the Dresden manufacturers have gathered a fund of 300,000 to 400,000 marks for distribution as prizes in the encouragement of amateur photography, and so on. This sort of common-sense enterprise is, as yet, neglected by our American manufacturers who, with the notable exception of the Eastman Kodak Company, do not recognize the need of the times, viz.: a larger and bolder advertising of photography. As a world hobby of unequaled attraction and interest, and as the most useful of applied arts, the volume of photography done in America could easily be increased a hundred fold by a more progressive view of the power of advertising.

The Wold Air Brush Mfg. Co. announces its removal to larger and better equipped quarters at 2173 N. California Ave., Chicago. Photographers interested in the possibilities of the air brush in photography should note the new address when visiting Chicago or writing for the firm's catalogues.

Vest Pocket Focal Plane. A British firm announces a V. P. focal plane camera, equipped with an anastigmat lens F: 5.5 in a focusing mount and a direct vision finder. It folds to $3\frac{3}{8}$ x $3\frac{3}{8}$ x 1 in.; for plates or filmpacks, and sells at less than $30.

PENTAC is the name of a new lens introduced by Dallmeyer Ltd., London, remarkable for extreme aperture and defining power. The Pentac of 3-inch focal length is said to have an actual aperture of F: 2.8, which is about 50 per cent faster than the F: 3.5 anastigmat hitherto regarded as the extreme speed for hand camera lenses.

A COMPETITION organized by an English firm of development paper manufacturers last year brought over 20,000 prints and enlargements for the judges to look over. This is striking testimony in favor of the widespread and persistent advertising of photography. When will our American manufacturers awaken to their opportunities?

LOST. The editors of *Abel's Photographic Weekly*, Cleveland, Ohio, are lamenting the loss of "One Coryphæus"—possibly one of the office mascots. "Any photographer finding same" is requested to communicate with the aforesaid editors immediately. Back to pre-war times, evidently, in Cleveland.

CIBA COMPANY, INC., now located in larger quarters at Cedar and Washington Streets, New York City, report gratifying success in their introduction of Metagol, "Ciba," the "100 per cent pure Mono-methylparamido phenol-sulphate." This fine product deserves its success. It possesses remarkable energy for a "soft-working" developer and, by reason of its super-purity, deteriorates very slowly, a big advantage in tank or quantity developing. Write for the Ciba Formulæ Book.

INTERNATIONAL. How THE PHOTO-MINIATURE does get around the world! In a single day's mail, recently, came letters postmarked Egypt, Japan, Malay Settlements, Australia, Italy, British Guiana, Brazil, France, and India. Today my correspondence is postmarked

Stockholm, Hong Kong, Corregidor (P. I.), Buenos Aires, with the manuscript of a book on "Artistic Portraiture" from Budapest.

A Practical Convenience for those who use the miniature cameras now so popular is the Griffin Plate Developing Tank, imported by R. J. Fitzsimons, 75 Fifth Avenue, New York City. This tank, available for plates 4½ x 6 cm., 45 x 107 mm. to 7 x 13 cm., and 2¼ x 3¼ in. to 5 x 7 in. is made of heavy nickeled brass and can be used for fixing and washing, as well as for developing the plates, thus eliminating any handling during these operations.

The Brieloff Reflectolite, which created a sensation at the recent Baltimore convention is, without a doubt, one of the most useful aids yet introduced for professional photographers. It is designed to replace the fifty-seven varieties of reflectors now used by professionals in controlling the lighting of the subject in the studio, apart from which it will prove immensely useful as a source of indirect lighting. Briefly it consists of two double mirrors mounted on an adjustable stand, the main mirror 18 x 30 in. being placed vertically between the uprights and the other placed overhead. Both mirrors are adjustable to different heights and angles and are made of aluminum, highly polished on one side for bright reflection and satin finished on the other side for soft reflection. Portraitists should send for the illustrated leaflet to the Prosch Mfg. Co., 61 Fulton Street, New York City.

G. Gennert, of New York, with branch depots in Chicago, Los Angeles, and Seattle, has undertaken the sole agency for the United States, Canada, and Mexico for the well-known Contessa-Nettel cameras. This line, already including forty different models, with many new styles in preparation for introduction during the present season, comprises the most extensive range of

high-grade photographic apparatus offered for the use of advanced amateurs.

The new models include an attractive variety of film cameras, of which the Piccolette and Cocarette are already available. These are typical examples of the Contessa-Nettel products, embodying novel features in design and construction making for simplicity and precision of operation, and presenting the highest quality of workmanship. The Piccolette is a vest-pocket camera of ingenious and distinctive design, beautifully compacted for precision and efficiency—two vital points in these very small instruments. The Cocarette is an elaboration of the same type, to be available in the popular 2¼ x 3¼, 2½ x 4¼ and larger sizes, made in teakwood finish as well as in the familiar leather-covered form, and is extremely rich and handsome in appearance.

Most of the Contessa-Nettel cameras are fitted with Carl Zeiss lenses made at Jena. Other models are equipped with the well-known lenses of Steinheil and Hugo Meyer Co.

The shutter fitted exclusively to the Contessa-Nettel focal-plane cameras deserves special mention. By an ingenious braking mechanism provided the uncertainty in operation encountered in some other focal-plane shutters is completely eliminated and perfect operation assured, with complete freedom from jar and strain.

In this introduction of their products to American amateurs, the Contessa-Nettel Company, of Stuttgart, assure the trade that the business in their cameras will be restricted to legitimate photographic dealers, so that the trade will be supplied from a responsible source offering reliable information and a complete service for the dealer's protection in handling the line.

Three Lens Booklets which offer much useful and profitable information to the professional photographer have recently come to my table. They deserve a careful reading and should not be overlooked. The first is "Studio Lenses," issued by The Wollensak Optical Co., Rochester, N. Y., and devoted to the choice and proper

use of lenses in all classes of studio work. The second is a beautifully illustrated list of Kalosat Lenses, issued by the Hanovia Lens Laboratories, Newark, N. J., giving detailed information about the Kalosat ("The Spectral Diffusion Lens"), a new soft-focus lens made of quartz, possessing remarkable speed and other advantageous qualities. The third is boldly labeled SPL —an abbreviation of the Struss Pictorial Lens, and explains in detail how to control this lens at full aperture, with twelve pages of testimony by enthusiastic users of the Struss, including quite a few prominent professionals. Copies of "SPL" can be had from Fredk. W. Keasbey, Box 303, Morristown, N. J.

A CAMERA LIST of more than ordinary interest and unusually well illustrated is the new "Ica Cameras" catalogue obtainable from Harold M. Bennett, 110 East 23d Street, New York, the U. S. Agent for Ica Cameras, Zeiss Lenses and Optical Products. The keynote of the Ica line is extreme compactness of construction combined with maximum efficiency. With one exception all the Ica models, for plates and film packs, roll film, reflex and stereoscopic, are equipped with the Zeiss Series Ic. F: 4.5, and in many a distinctive feature is the Iconometer or direct vision wire finder, which is undoubtedly the best of finders for miniature cameras of the folding type using lenses of short focal length.

"EVERY CLICK A PICTURE" is the alluring title of a booklet which Burke & James Inc., Chicago, offer to send to all who write for it. It is written by H. C. Phibbs for the beginning amateur with a hand camera and compresses into 17 pages a lot of very practical information of the sort the beginner needs.

HAVE YOU A CAMERA CLUB IN YOUR TOWN? If not, get into communication with Mr. Louis F. Bucher, 880 Broad Street, Newark, N. J., and ask for a copy of

his booklet on "The Organization and Management of a Camera Club," published for free distribution by the Associated Camera Clubs of America.

We should have a Camera Club in every progressive town, but those who have attempted to organize such an association of amateurs know how troublesome and lonesome a task this is, largely because of the lack of information and experience. In his 24 pages Mr. Bucher sums up the experiences of many existing camera clubs and tells just how to go about the work of organization, management, and successful conduct of a camera club. I hope it will have the wide circulation it deserves.

The Paasche Air Brush Co., Chicago, sent an attractively illustrated folder of their new model air brushes and equipment. The new Paasche Model "A" brush is an ideal tool for photographic uses, tinting or coloring photographs, working up enlarged portraits and negative work where fine detail is concerned.

Printing by Projection is the general subject dealt with in two very interesting booklets issued by the Eastman Kodak Co. These explain the advantages and use of the Eastman Projection Printer for making large prints up to 30 x 40 from 5 x 7 negatives, and the new Kodak Projection Printer, for amateur finishers, giving prints up to 24 x 32 from plate or film negatives 4 x 5, 3¼ x 5½ or smaller.

The Agfa Film Pack, imported by the Sagamore Chemical Co., New York, offers two improvements which will commend it to amateurs on tour or vacation. Its twelve flat films are encased in a thin metal container and, after exposure, pass over smooth metal rollers, by which all danger of friction streaks or dust scratches is eliminated. See it at your dealer's.

Books and Prints

WELL DONE! AUSTRALIA. The photographers of Australasia cover themselves with glory in the Seventh All-Australian Number of the *Photo-Review* just received. This publication, fully equal in technical content and illustration to the best American and British journals, is published by Kodak Ltd., Sydney, under the able editorship of Walter Burke and his son E. Keast Burke.

THE BOSTON Y. M. C. UNION CAMERA CLUB held an exhibition of its members' work during April. About 270 prints were shown, representing some 40 exhibitors. The illustrations of the catalogue, and an appreciative review of the exhibition, by Henry H. Saunderson in the *Boston Transcript* indicate that the work shown was of outstanding quality. Mr. Herbert B. Turner, the President of the Club and an enthusiastic pictorialist exhibited, among other prints, a wharf scene including the Tower of the Boston Custom House which deserves special mention.

THE SILVER BROMIDE GRAIN IN PHOTOGRAPHIC EMULSIONS. By A. H. P. Trivelli and S. E. Sheppard. 143 pages, illustrated; cloth $2.50. 1921. Rochester: Eastman Kodak Co. New York: D. Van Nostrand Co.

The scientific results obtained in the Research Laboratory of the Eastman Kodak Company are published, in the form of Communications and Reports, in various scientific and technical journals here and abroad, but the work of the Laboratory on the theory of photography is of such importance and of so general a nature that it has been decided to prepare a series of mono-

graphs covering this special field, for the information of investigators and research students.

The monograph here noticed is the first of the series to appear. It deals, in a severely technical manner, with a very complete crystallographic study (involving photomicrographic work of a high order) of the small grains of silver halide which, imbedded in gelatine, form the photographic emulsion. As a result "it has been possible to confirm the fact that the grains of high-speed emulsions are definitely crystalline, to identify their crystalline form and to show that all the grains, though having several distinct shapes, belong to the same crystalline class. The grains being thus established as micro-crystalline, their formation in the emulsion can be studied by the aid of the recent physico-chemical theories of precipitation and especially of the dispersion theory of Von Weimarn, according to which the dispersity of the initial precipitate will be determined by the concentration of the solution and other physical conditions." Which extract from the Preface is given, not merely as advising the reader of the content and style of the monograph, but also to emphasize the fact that it deals entirely with theory and is in no sense a popular or simple account of its subject.

The tiny grains of silver halide which are here so exhaustively studied are, however, the fundamental units of the sensitive material on which all our photography depends, so that their chemistry and crystallography have a vital interest for the student of photographic theory, and the work of Dr. Mees and his associates Dr. Trivelli and Dr. Sheppard will materially influence the future development of photographic methods and practice.

The illustrations of the monograph are exceedingly interesting and some of them (e. g. Seed 30 emulsion magnified 2500 diameters) present curiously intricate designs of unsuspected beauty.

Bibliotheca Chemico-Mathematica: Being a Catalogue of Works in Many Tongues on Exact and Applied Science. With a subject index and 127 plates,

containing 247 portraits and facsimiles. 2 vols. large 8vo. xii + 964 pages. Cloth. 1921. London: Henry Sotheran & Co.

A remarkable catalogue, the most comprehensive I have seen in its field, describing and annotating over 17,000 scientific works, ancient and modern. Many of the classics of photography, such as Daguerre's announcement of his discovery, Hunt's early manuals, Verdant Green's "Pleasures of Photography," etc., are included in this *omnium gatherum* which fairly teems with curious interest. The subject-index of 96 double-column pages gives direct access to every item in the book, and the illustrations offer a valuable collection of portraits, title pages and engravings of epoch-making inventions, including Daguerre's apparatus. The work should be of great usefulness to scientific and technical libraries.

How To Become a Professional Photographer is the title of a richly illustrated brochure issued for free distribution by the New York Institute of Photography, 141 West 36th Street, New York City. It gives a capital résumé of the possibilities of photography as a profession, the courses available at the Institute, and terms.

The Exhibitions of the passing season have been more numerous and more ambitious than for many years. I have seen most of them and a few interesting pages already in type give my comment upon their chief features. Unfortunately, the continued pressure upon my space again compels me to omit these brief reviews. I hope to publish them in the May issue.

The Photo-Miniature
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EDITED BY JOHN A. TENNANT
Volume XVI July, 1921 Number 183

Color Photography

From the beginning of photography it must have occurred to everybody who has taken photographs that it would be an enormous advantage if the photographs could reproduce not only the lights and shades but also the color of natural objects. Charles Kingsley, who was an ardent devotee of the photographic art at the time when he had to make his sensitive materials for himself and when the taking of photographs meant a serious study of applied chemistry, in one of his books talks of the possibility of a time when the photography which he was using to depict the form and texture of his much-beloved plants and animals would be able to show as well the natural living colors of the objects; but these dreams remained only dreams until that great day in 1861 when Clerk Maxwell, at that time the greatest physicist of the world, and one of the greatest who have lived, lectured before the Royal Institution in London on his theory of vision, in which he held that the eye has three color sensations, separate sets of receiving organs being responsible for the perception of red, and of green, and of blue-violet, and that all colors are perceived as mixtures of these three primary colors to a different extent. To illustrate this, Maxwell had taken three photographs, one through a red solution, one through a green solution, and the third through a blue solution, and from these three negatives he had made three lantern-slides which he threw on the screen on top of one another by means of three lanterns, each

one projecting its slide through the solution which had originally been used for taking the negative. From these three primary colors, red, green, and blue-violet in the correct proportions, any color required can be obtained. Thus if red light is thrown on the screen and green light added to it, we shall get first orange-red and then orange, which, as the intensity of the green grows in proportion to the red, finally becomes yellow. Similarly, the addition of green to blue-violet produces shades of blue-green and finally of pure bluish green exactly opposite to the red sensation in color, while mixtures of red and blue produce all possible shades of violet ranging through magenta into purple (see Fig. 1). Since the three colors together represent

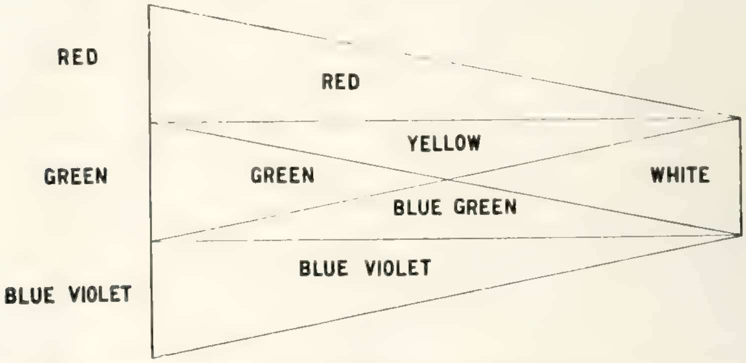
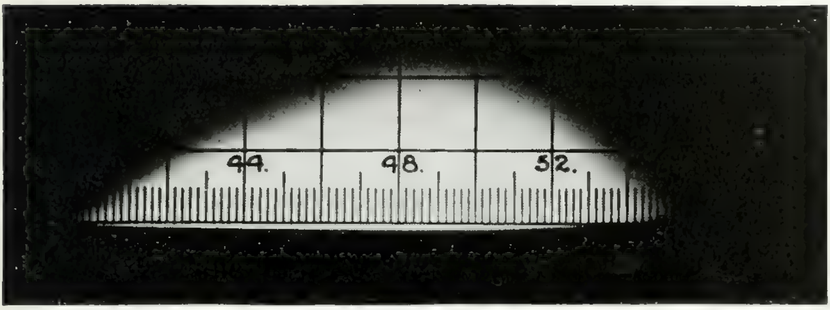
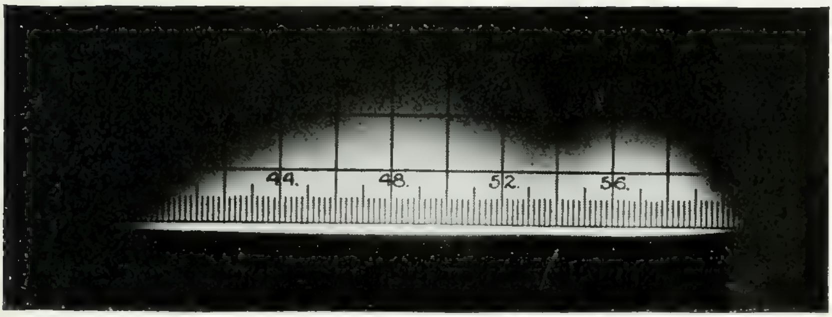


FIG. 1. Mixture of three primary colors to produce white light

white when they are mixed in equal proportion, we can dilute any of the strong colors—red, yellow, orange, green, blue-green, or blue-violet—by the addition of one or two other colors.

The greatest difficulty which Maxwell encountered was the lack of sensitiveness to red and green which was shown by the photographic materials which were at his disposal. Maxwell had to use wet collodion, and wet collodion is scarcely sensitive at all to green or to red light, so that he had great difficulty in obtaining records through the red and the green filters. In fact, he states in his lecture that this is the cause of the unsatisfactory result which he was able to throw upon the screen. When the gelatine-bromide process





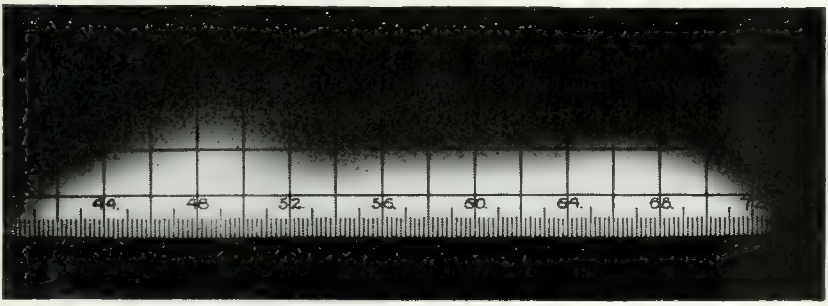
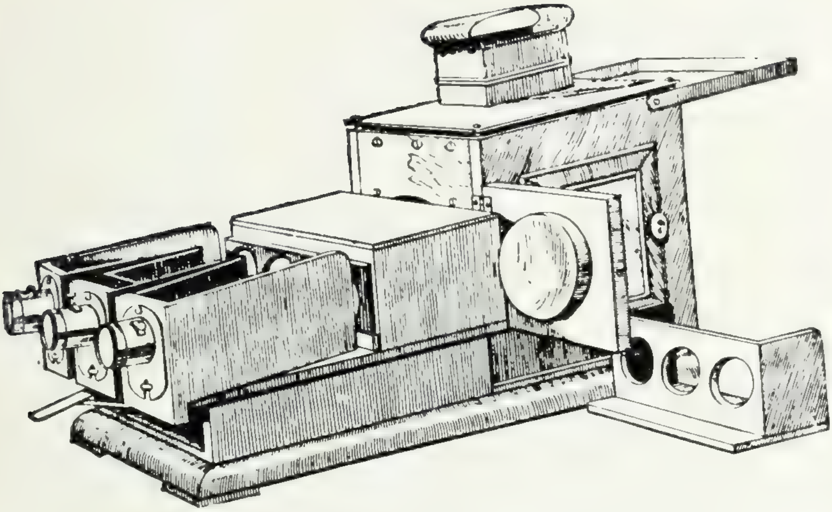


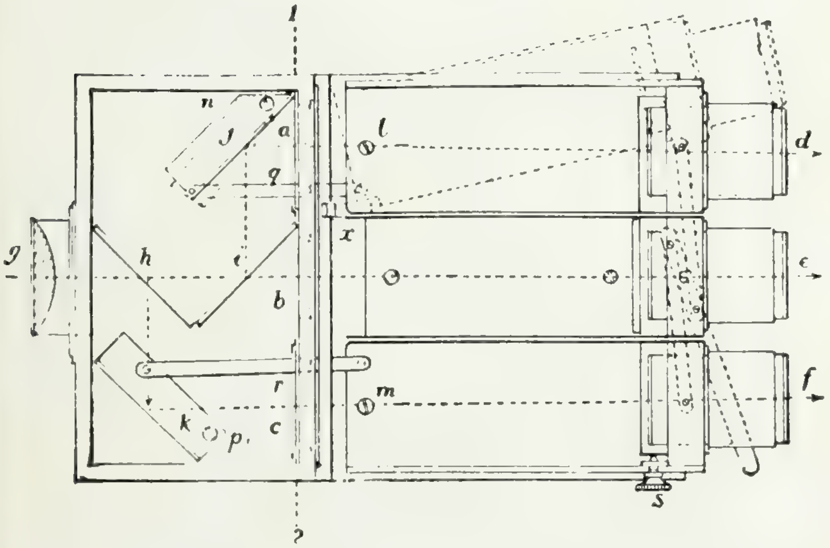
FIG. 2. Spectrum of ordinary plate
FIG. 3. Spectrum of ortho plate
FIG. 4. Spectrum of panchromatic plate

was discovered, the sensitiveness of the emulsion produced by it was still confined to the blue-violet and ultra-violet regions of the spectrum (Fig. 2), and sensitiveness to the green and red was not obtained until Vogel, in 1873, discovered when working with collodion emulsion that if he added to the emulsion some dye (Vogel used eosine), it became sensitive to the yellow-green region of the spectrum which is absorbed by the eosine dye (Fig. 3). Emulsions sensitized in this way are called *orthochromatic*. Within the last fifteen or twenty years, however, new sensitizers have been discovered, chiefly by Dr. König of the Hoechst Dye Works, and these sensitizers make the emulsion sensitive to the entire spectrum, so that emulsions sensitized with them are termed *panchromatic* (Fig. 4). By the use of the best of these sensitizers, photographs can be taken through red or green filters almost as easily as they can be taken without a filter, although the filters increase the exposure required, about ten times the exposure without a filter being required.

Aside from improvements in the emulsion, great improvements in the filters have been made since Maxwell's time. Instead of glass-walled tanks filled with solution such as Maxwell used, it is now possible to obtain color filters consisting of dyed gelatine cemented between pieces of glass, which are not only more convenient to use but which also give better results than the solutions which Maxwell had at his disposal. It is the improvement in the sensitizing of the plates and films and in the making of the filters which has made all improvements in color photography possible.

The method of obtaining color photographs by taking three negatives through three color filters, making from them three positives, and then projecting them again through filters similar to those through which they were taken has been utilized by many inventors since the time of Maxwell. F. E. Ives was the first worker to obtain first-class results by this process. He made three negatives on one plate in a repeating back side by side, carrying the filters in





UPPER FIG. 5. Ives' Triple Projection Lantern
LOWER FIG. 6. Diagram showing interior design

front of the plate. A positive printed from this triple negative was then projected in a special triple projection lantern arranged so that the three images could be made to coincide upon the screen (Figs. 5 and

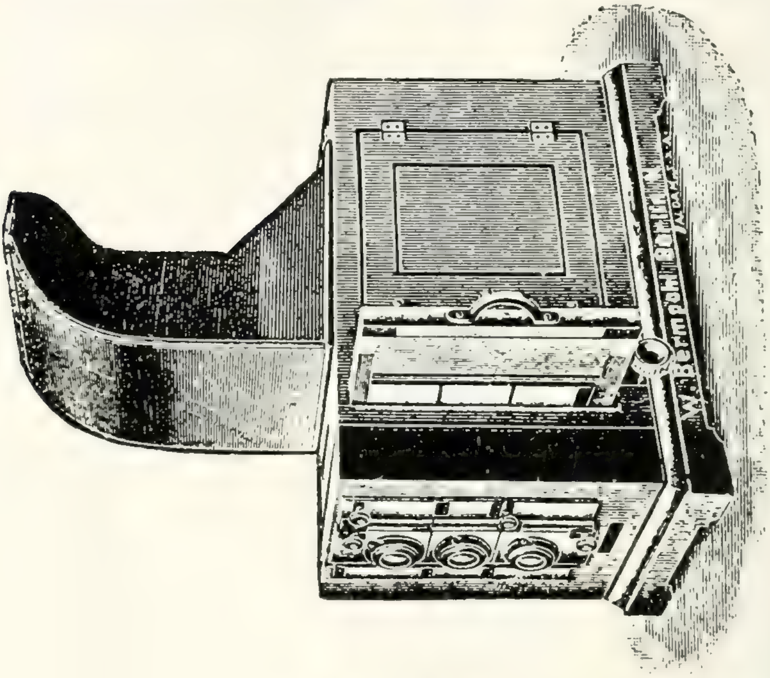


Fig. 8. Miethe Three-Color Projection Camera

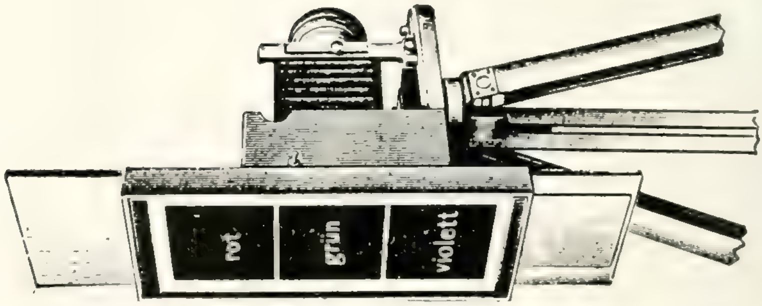


Fig. 7. Miethe Three-Color Taking Camera

6). With this apparatus very beautiful results were produced by Ives, who also designed a number of special cameras for the purpose of taking the three records simultaneously. Professor Miethe in Berlin has again exploited this process. He used a triple projection lantern consisting essentially of three lan-

terns, one over the other, like an old-fashioned triple lantern, the negatives being taken on one plate which was allowed to fall in a repeating back so that the negatives were one over the other (Figs. 7 and 8), and from this plate a positive was printed which was

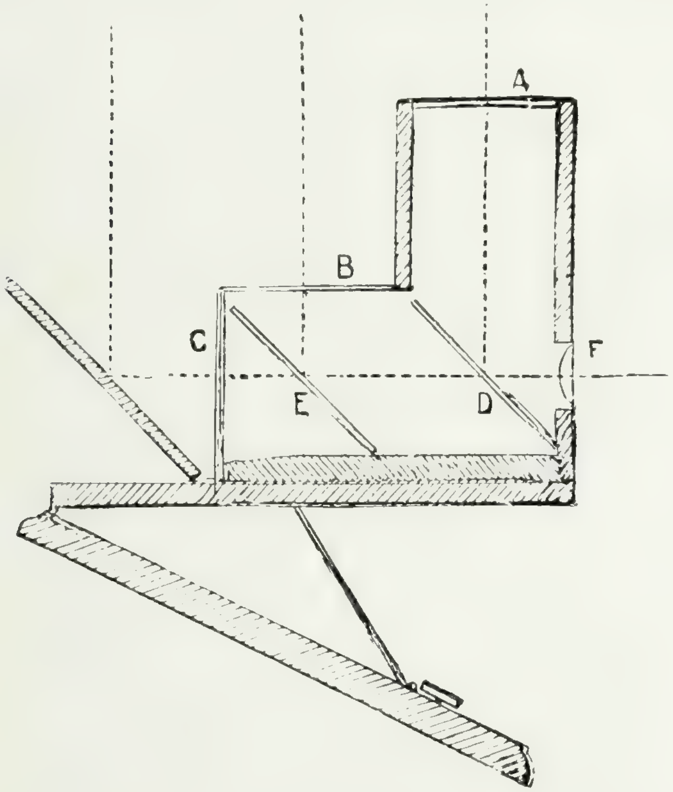


FIG. 9. Ives' Chromoscope

put into the projection lantern. Lastly, Gaumont has used the process for three-color moving pictures, making the pictures very small, so that three pictures fall into the space of two ordinary cine pictures, and projecting them through a very ingenious triple lens.

The greatest objection to this process was that the pictures could only be seen when projected by a rather elaborate lantern. In order to overcome this objection, Ives designed his chromoscope, in which the three positives are placed over filters and their images

are superimposed by means of mirrors so that the three pictures can be observed simultaneously. This very ingenious apparatus is shown in Fig. 9. Most people, however, want pictures to put either on the walls of their rooms as prints or in such a form that they can hold them in their hands and examine them, so that the efforts of inventors in color photography have been directed towards getting some form of color photograph which could be seen apart from a projection lantern.

Ducos du Hauron. In 1869 there was published a very wonderful little book called "La Photographie des Couleurs," by a Frenchman, Ducos du Hauron, and in this book Du Hauron outlined almost all the possible processes of color photography which have since been worked out. One of these processes is that which has since become of practical importance and which is known as the *screen-plate process*. What Du Hauron suggested was that we might cover the surface of a glass plate or film with tiny filters—red, green, and blue—and then coat on the top of this the color-sensitive emulsion and photograph through the color filters so that the image is cut up into a lot of little sections, each bit of which is taken through one of the three filters.

Joly. The problem in working this out in practice was to make the plate with the filters. This may be done by ruling lines by means of a pen containing colored ink. The first attempt to do this with fine lines was made by Professor Joly at Dublin in 1894, who ruled alternate lines of red, green, and blue-violet on a glass plate by means of a ruling machine, and then registered with this glass plate the necessary plates on which the image was made, making a lantern-slide from the negative so obtained and again registering the lantern-slide with the screen, as he called it, to obtain the colors (Fig. 10). Joly was quite successful in getting good results, although his lines always showed somewhat.

Following Joly many other attempts have been made to prepare screen-plates which might be commercially applied to the production of photographs in color.

A great many of these attempts stopped, so far as public records are concerned, at the stage where they were patented; others have progressed to the point where they were publicly announced as being ready for the market; still others have actually been sold, while a few, a very few, have been sufficiently successful to be made for a considerable period.

In some types, the screen is prepared to be used with separate panchromatic plates, as was the intention of

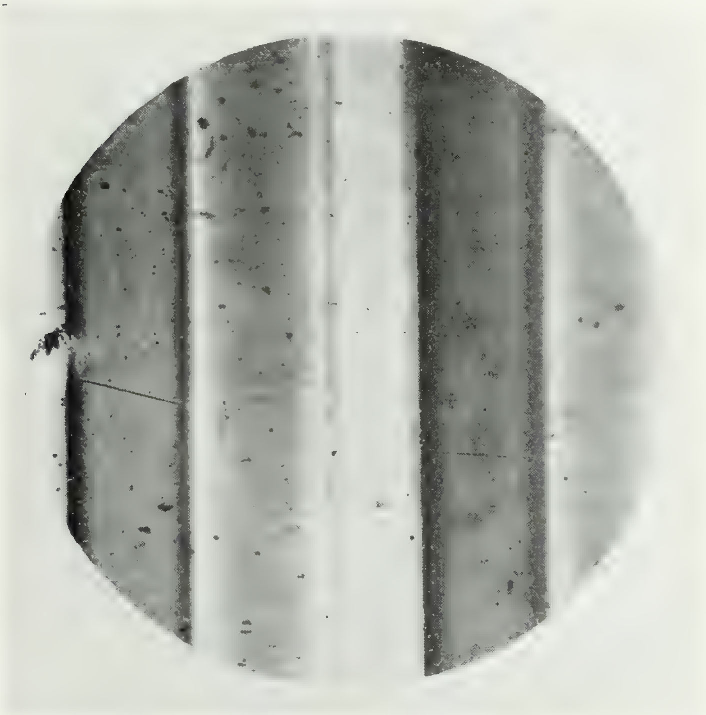


FIG. 10. Photomicrograph of Joly screen

Joly, while others are made with the emulsions coated actually on the filter screen.

The methods of preparation of the filter screen may be classified as follows:

1. Ruled Lines. In addition to the Joly screen, MacDonough, in Chicago, tried to produce screens by this process, the lines being ruled by special machines

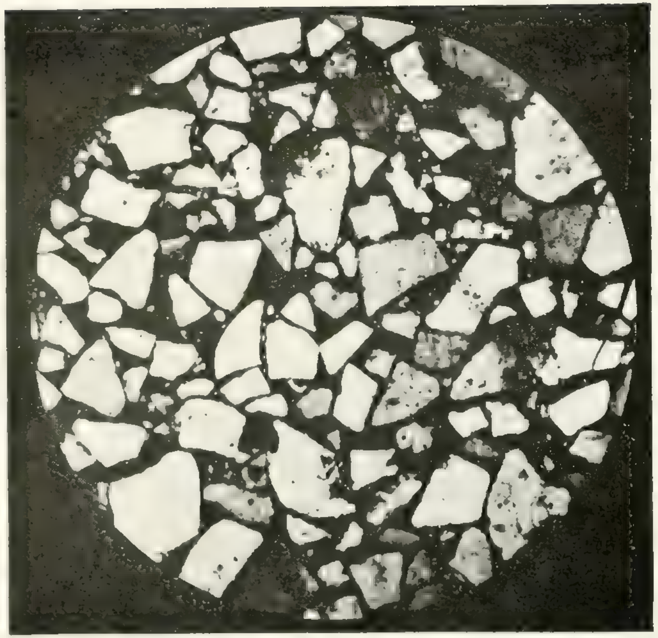


Fig. 11. Irregularly sized particles

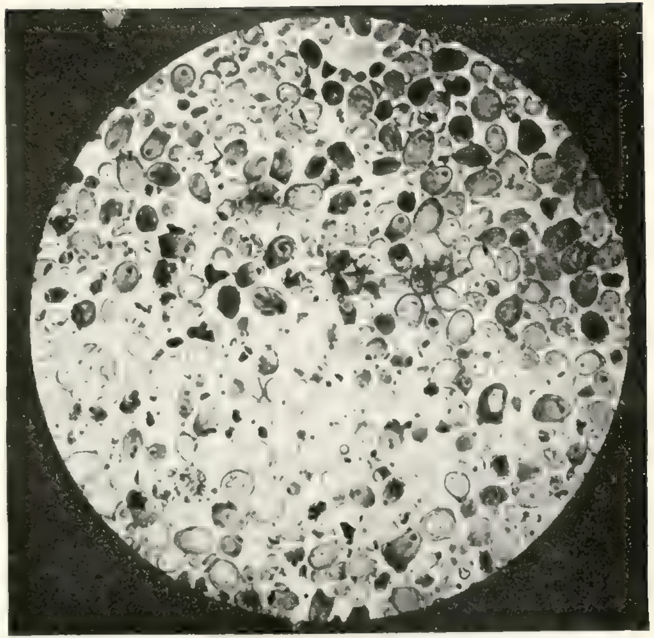


Fig. 12. Screen made by dusting on colored particles

using very small ruling wheels, but the screens cost too much to produce for commercial success.

2. **Dusting-on Methods.** MacDonough also tried this; he coated a tacky varnish onto the surface of a glass plate and then dusted onto this small colored particles, such as colored gelatines, shellac, or resins.

An example of such a plate made by dusting on irregularly sized colored particles is shown in Fig. 11, and a very poor experiment in Fig. 12.

Lumière. About 1904 there was issued a French patent to the Lumière Company. This was for separating from potato starch the very small grains of the starch, sieving them to pick up those of the same size, and dividing the grains so obtained into three heaps, each of which was dyed in one of the primary colors, then mixing the three heaps together and dusting them onto glass plates covered with a sticky varnish (Fig. 13), then squashing down the starch grains so that they touched each other all over the plate, filling any interstices that might be left with a black powder, varnishing (Fig. 14), and then coating the plate with the necessary sensitive emulsion. This was accomplished successfully by the Lumière Company and the plates so made were issued as the "Lumière Autochrome" plates, with which most of the color photographs known to the public have since been made.

Autochrome. The action of the plates is shown in Fig. 15 (from drawings by E. A. Salt), in which Diagram 1 illustrates the use of the plate as a whole. In this diagram *L* is the lens and *F* a compensating filter placed over the lens, by which the greater sensitiveness of the emulsion for blue light is corrected, and equal densities are obtained below the three unit filters. The glass plate itself is shown at *A*, the color filters are shown diagrammatically at *B*, and the emulsion at *C*, so that the light from the lens after passing through the compensating filter reaches the back of the plate and passes through the filter units made of dyed starch grains and coated upon the glass before it reaches the emulsion. The exposures required are somewhat long, averaging one second in good sunlight with an aperture of $f:8$. In Diagram 2, blue light is

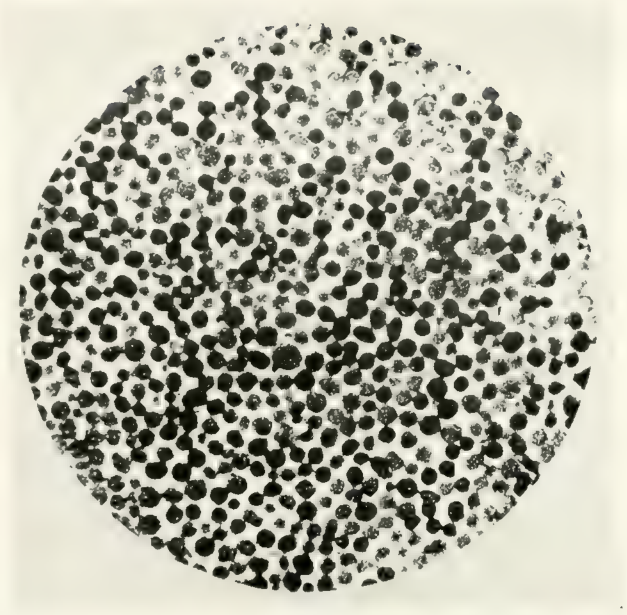


Fig. 13. Photomicrograph of Autochrome plate before rolling

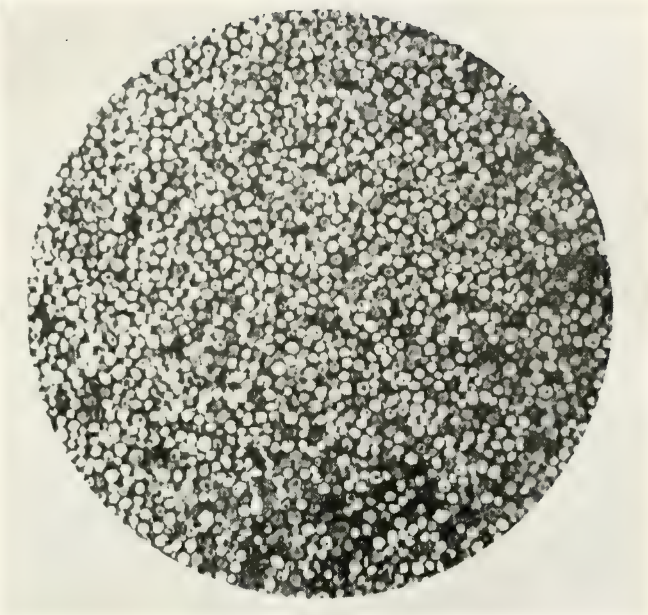


Fig. 14. Photomicrograph of Autochrome plate

supposed to fall upon the plate, and being stopped by the red and green filter units, passes only through the blue filter units, affecting the emulsion, *C*. After development, we have the condition shown in Diagram 3, white light now being considered to fall upon the plate and to pass through the green and red units and, impeded by the unfixed silver bromide, through the emulsion, while the light falling upon the blue units is

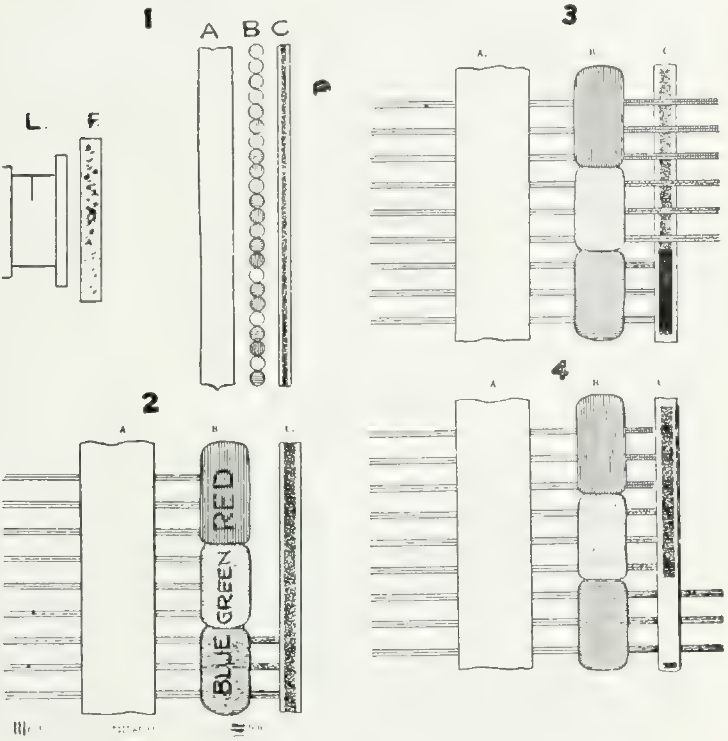


FIG. 15. Diagram showing use of Autochrome plate

completely stopped by the silver which is developed after exposure to blue light. The plate is not fixed after development but is reversed by means of a bleaching solution which removes the silver image, the bleaching solution usually being an acid solution of permanganate. After bleaching, the remaining emulsion is developed and is thus blackened under the red and green units, so that, as is shown in Diagram 4, the

light passing through these units is stopped, and only the light passing through the blue units is able to traverse the emulsion where the silver which was originally developed under those units has been removed by the bleaching-bath. In the original process the positive image obtained by reversal was intensified, though later the Lumière Company worked out formulæ for development which did not require intensification. So skillfully are the plates made and so exactly are the colors of the separate starch grains, the color sensitiveness of the emulsion, and the color of the compensating filter balanced, that the process gives excellent results, while it is by no means difficult to work, and it has thoroughly deserved the wide popularity which it has enjoyed.

3. **Printing in Bichromated Colloids.** When such colloids as gelatine, fish glue, etc., are treated with a solution of bichromate, dried and exposed to light, they become insoluble in water. If, then, a glass plate be coated with a solution of bichromated fish glue, and the coated plate be exposed to light under a black line screen which allows only one-third to be exposed at a time, two-thirds being protected by the black lines, and then washed in water, one-third of the entire surface will be covered by lines of fish glue, which can be dyed. After the dye has been mordanted to prevent it running, the plate can be recoated with glue, registered in position on the printing screen, and printed so as to get a second glue line which can be dyed in the second color, provided that the first line has been protected from the action of the dye by coating it with a varnish or otherwise. The third line can be printed by exposing the plate through the back, when the first two lines will act as screen for the third, and in this way we can build up a three-color line screen.

This process has been used by several inventors, notably by J. H. Powrie, by the Thames Company in England, who put screens on the market for a short time, and by the Paget Company, who have been successful in competing for some years with the Lumière plates.

FIG. 16. Photomicrograph of Krayn Mosaic Screen

FIG. 17. Photomicrograph showing clumping of Autochrome particles

4. **Screens Made by Section Cutting.** In Germany, Krayn took out a patent for an ingenious process. He took thin sheets of colored celluloid of the three primary colors and piled them on top of one another so as to get a pile of alternate layers of red, green, and blue. By cutting sections down through this pile, sheets of celluloid were obtained made up of strips of each of these red, green, and blue layers. In order to get a screen made of squares instead of lines, Krayn took a pile of his line screens and stuck them together, and then cut these across again, so that now he had one made up of cubes of the different colors. It was, however, very difficult to make these screens fine enough, and the thickness was also a disadvantage (Fig. 16).

5. **Screens Made by Mechanical Printing,** or a combination of this with dyeing. This will probably be the method by which such screens will be made eventually if the screen-plate processes ever become of great commercial importance, but up to the present no really good screens have been made in this way.

A number of other methods are possible and have been proposed for making the screens, but those already enumerated are the chief.

Screen Factors. Assuming that a method of placing units upon a glass plate or other support, to form a screen has been devised, we must consider the following factors:

(*a*) The size of the units. For regular screens these should not be larger than 1–300th inch, nor smaller than 1 600th inch; for irregular grain screens not larger than 1–900th inch nor smaller than 1–2000th inch.

The units for an irregular grain screen must be smaller than for regular screens because in practice they tend to clump together, so that the effective unit when examined is much larger than the single units (Fig. 17). On the average, it may be taken that the effective unit when looking at an irregular grain screen is a clump of ten units, so that the diameter must be made three times smaller than is absolutely necessary from the point of view of invisibility.

Since the resolving power of the emulsion is only

just sufficient for use with these small units, if the units are much smaller the emulsion will not be able to resolve them and consequently correct color rendering will not be obtained. The resolving power of the emulsion therefore places a lower limit to the size of the unit which can be employed in a screen plate.

(*b*) The interstices. If these exist at all, they must be filled in; clear interstices are fatal, even if they occupy only 1–20th of the area of the screen plate.

(*c*) The colors of the units. These must be primary red, green, and blue-violet.

(*d*) The relative area occupied by each color. These must be adjusted so that the screen as a whole appears neutral.

(*e*) The emulsion. This must be coated or on a varnished surface to protect the screen units from the moisture. The varnishes must be selected so that they will not act upon the emulsion. Turpentine and ether, especially the former. are inadmissible as solvents; resin varnishes are suspect.

(*f*) The sensitizing. This must be performed so that the actions under the red and green filters are equal.

(*g*) The compensator. This must be adjusted so that the photographic effect renders grays as grays owing to equality of action through all three filters.

Limitations of Screen-Plate Process. Beautiful as are the results obtained by the best of the screen-plate processes, and notably by the Lumière Autochrome plate, these processes have some very marked limitations, especially when applied to portraiture. In order to get sufficient resolving power with reasonably fine units in the screen, the emulsion has to be coated so thinly that the range of gradation which it can render is very limited, and only under the most favorable circumstances is it possible for a screen-plate color picture to reproduce the gradation both in the highlights and in the shadows, so that if a photographer wishes to employ this process, which is by far the most easily worked color process, he must limit himself to the subjects for which the process is suitable. Moreover, the pictures

produced involve a great loss of light, so that they can be seen only with a very powerful light behind them, and inasmuch as they are made by daylight, they should be viewed by light similar to daylight, the results by artificial light being unsatisfactory.

A method of color photography which was also suggested by Du Hauron, and which has great advantages in some respects, is that which is known as the subtractive process; indeed, it is convenient to divide the processes of color photography into the additive processes and the subtractive processes.

Additive and Subtractive Processes. When a color picture is projected on the screen by means of a three-color projection lantern, one image will be projected in green light, one in red light and one in blue light, the three-color pictures made in this way by adding three different lights being said to be made by the additive process. Suppose, now, that over a sheet of yellow gelatine, which will absorb the blue light, is put a sheet of magenta gelatine, which will absorb the green light; then, since the yellow absorbs the blue light, and the magenta the green light, only the red light is transmitted, a red image can thus be obtained either by projecting it through a red filter or by putting a magenta image on the top of a yellow one. In the same way a green image can be obtained by putting a blue-green one on the top of a yellow one, when the yellow will cut the blue out of the blue-green and leave only green (Fig. 18). On this principle is based the subtractive process.

In working the subtractive process, the three negatives are taken just as for the additive process, and then positives are printed in some way which enables them to be made colored, the commonest being to make them by dyeing gelatine. If gelatine is soaked in bichromate of potash and then exposed to light, it becomes insoluble in hot water where the light has acted upon it, so that if a sheet of film coated with gelatine containing bichromate of potash be exposed under a negative, and then washed in hot water, the gelatine will be left in its full thickness where the light has acted strongly upon it, and washed right away where the negative has pre-

vented the light acting, so that the picture will be represented in thickness of gelatine. If this is ordinary gelatine, the picture will scarcely be visible, because the gelatine is so transparent that the difference in its thickness is imperceptible, but if it is soaked in a dye

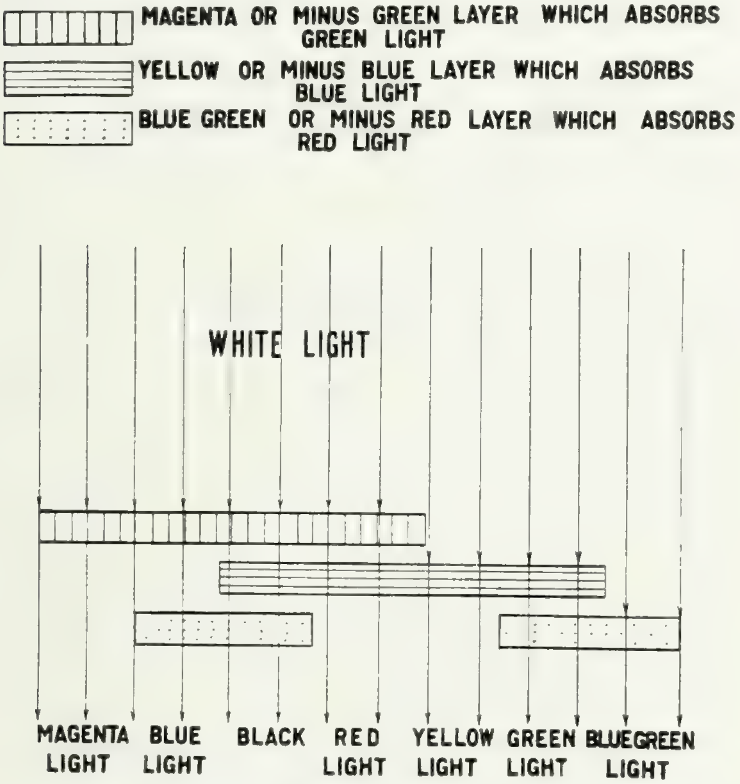


FIG. 18. Diagram showing rendering of colors by the Three-Color Subtractive Process

solution, the gelatine will be colored according to its thickness, and the picture will be represented by the varying depth of colored dye. By this process, the three negatives can be printed in colored dye, the picture taken through the red filter being printed on gelatine dyed blue-green, the one taken through the green filter on gelatine dyed magenta, and the one taken through the blue filter on gelatine that was dyed yel-

low, and, now, if the three are cemented together in register the resulting transparent color picture will reproduce the colors of the original subject, and will be a transparency which can be viewed in the hand or examined in front of an artificial light or projected in a lantern. This process gives very good results. It is a little difficult to get the gradation of such a picture first-rate, and the registration of the three different pictures is not very easy, but otherwise the results are splendid; it is, however, not at all easy to work. The making of the three different negatives itself offers difficulties, but the printing and dyeing of the gelatine reliefs so as to get them all printed alike and all developed to the same extent are so difficult that the process has not yet been a commercial success.

Two-Color Processes. One simplification in color photography is the substitution of two colors for three, and in one of the best-known processes of color photography this has been made. In the Kinemacolor process of color cinematography only two negatives are used—a red and a green—and positives from these are projected alternately upon the screen through red and green filters.

Now, while with the three-color process we cannot expect to get results from the subtractive method equal to those given by the additive, in a two-color process the possibility of getting a satisfactory result with the subtractive method is somewhat greater than with an additive method, because in order to get the whites and blacks with the additive two-color process, it is essential that our two colors should be exactly balanced to each other or "complementary," as it is called because otherwise they would not give white on the screen, and this condition that the two colors should be complementary to each other greatly limits the range of colors which we can obtain. When working the subtractive process, on the other hand, whites are got by the absence of any color at all, and blacks by both colors in full strength, so that we can use colors which are not exactly complementary to each other, and the range of possible colors which can be obtained is greatly extended.

COLORS	REPRODUCTION BY TWO COLOR PROCESS
BLACK	BLACK
PURPLE	BROWN
BLUE	BLUE GREEN
BLUE GREEN	BLUE GREEN
EMERALD GREEN	GREEN
YELLOW GREEN	VERY LIGHT GREEN
BUFF	EXTREMELY LIGHT RED
YELLOW	VERY LIGHT RED
ORANGE	LIGHT RED
RED	RED

FIG. 19. Chart showing rendering of colors by the Two-Color Process

In Portraiture. The two-color subtractive process based on this principle is found in practice to give very excellent results, especially for portraiture, the flesh rendering being notably accurate. It is, of course, not suitable for landscape photography, where blues and greens predominate. Since only two colors are used in the process, it is obvious that all colors cannot be correctly rendered, and the colors for which the process fails are the blues, violets, magentas, and purples. Light blues appear blue-greens, and violets black; magentas appear pink, and purples dark brownish red. On the other hand, flesh tints of all kinds and all shades of red, orange or green, grays and blacks are well rendered (Fig. 19). As these are predominant in portraits, the results are very satisfying for this class of work. Many of the pictures appear to show blues fairly well, but this is because, by contrast with greens, blue-greens look blue, and especially by artificial light the eye is accustomed not to expect very much of blues. The failure in color rendering is more obvious by daylight, and the pictures appear at their best when placed in a special illuminator, giving a much truer color rendering.

Clinical Photography. The two-color subtractive process is peculiarly suitable for clinical photography and for photomicrography. Since blues are almost absent in clinical photography, the two-color process is quite satisfactory for the photography of skin diseases or of pathological and anatomical sections, and lantern slides made in this way are far more effective for teaching purposes than the same subjects reproduced in black and white only.

Photomicrography. In the case of microscopic specimens, most sections to be dealt with are stained in not more than two colors, and very good results can be obtained by making two-color lantern slides. The method of work is to choose special filters according to the specimen, each of which absorbs one of the colors as much as possible and transmits the other, the two filters being necessarily complementary to the stains used, and from the two negatives made through the filters, prints are made either by the bleaching and dyeing process already described, or in bichromated gelatine.

Thus, suppose a section is stained red and green. Make two negatives on panchromatic plates, one with a red filter, which will cause the green to appear clear in the negative and will not record the red, and the other with a green filter which will cause the red to record and not the green. Then make prints from these in bichromated gelatine, staining the print from the red negative with the original green stain and then that

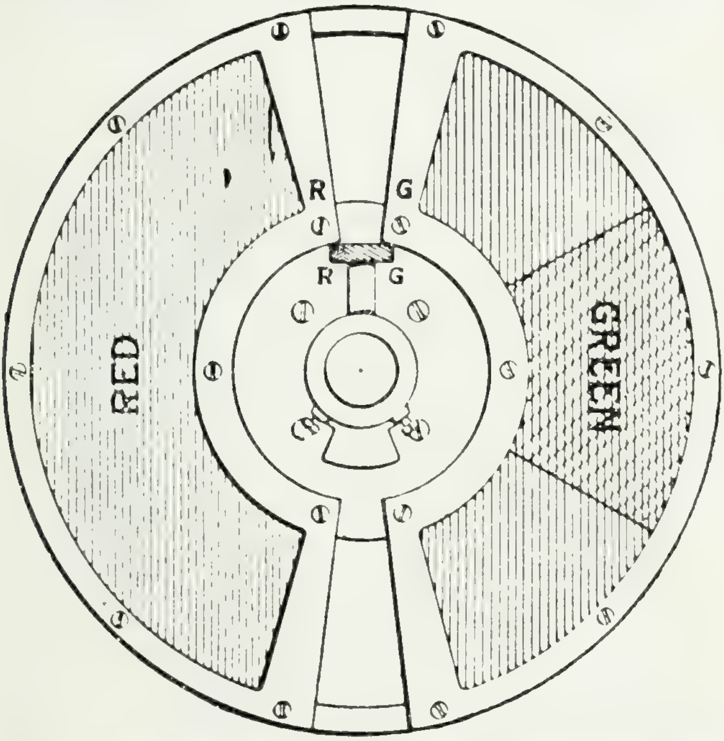


FIG. 20. Color Filter Rotating Disk for Kinemacolor Camera

from the green negative with the original red stain and superpose the prints. It will be found that lantern slides made in this way will reproduce the original appearance of the slide in a most satisfactory manner.

Color Cinematography. The various processes of color photography which have been described are all applicable to motion-picture work, though owing to the long exposures required and the loss of light by absorption, no practical process utilizing the principle of

the screen-plate for cinematography has as yet been developed. The motion-picture processes are, however, like other processes of color photography, divided clearly into additive and subtractive processes, and, as in the case of the photography of stationary objects, the additive processes developed first.

In the case of motion pictures, there are two methods of additive synthesis. Either one may project on the screen the three pictures simultaneously, as is done in the triple projection lantern, or the color units may be projected successively, relying upon persistence of vision for the blending of colors.

Kinemacolor. The earliest practical cinematograph color process was a two-color process utilizing persistence of vision for the addition of the pictures. By means of a rotating disk (Fig. 20) of color filters placed in front of the camera, pictures are taken on panchromatic film alternately through a red and a green filter, the pictures being taken at twice the normal speed, so that for each complete picture two negatives are made, one through each filter. The positives from these negatives are projected through a machine similarly equipped with a rotating shutter, which is made to operate synchronously with the picture. so that the pictures taken through the red filter are again projected through a red filter, and the green pictures similarly through a green filter (Fig. 21). The succession of red and green pictures upon the screen produces complete synthesis by persistence of vision and gives the effect of a two-color additive picture. This process is known as the Kinemacolor process and has enjoyed a considerable success.

Gaumont. The most complete and satisfactory process of color cinematography is undoubtedly the simultaneous three-color additive process worked out in its complete form by Gaumont Three lenses are used in the camera and three pictures are taken through the primary color filters upon the same strip of film. A normal motion picture is 1 inch wide by ¾ inch high and corresponds to four sprocket holes in the film. The Gaumont pictures are three sprocket holes instead of four for each color so that the

whole set of color pictures corresponds to nine sprocket holes, and the film is two and a quarter times the length of the standard film (Fig. 22). After each exposure, the film is pulled down, therefore, the length of nine

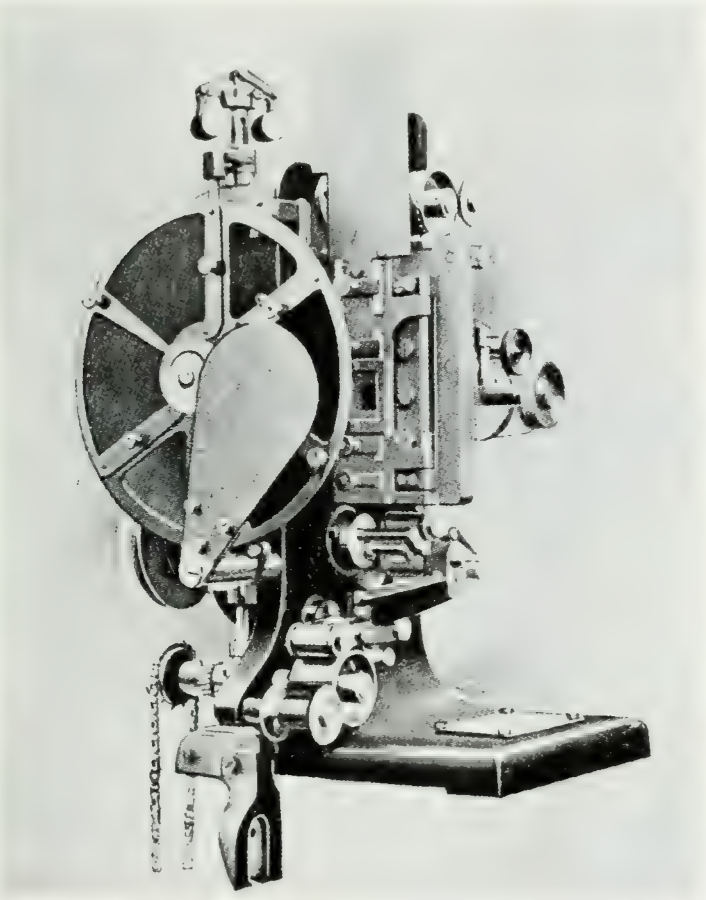


FIG. 21. Kinemacolor Projecting Machine

sprocket holes at one time, and a new set of pictures is taken, sixteen pictures a second being exposed just as normal pictures. The positives are projected in a machine fitted with a corresponding pull down and gate and with three condensers and three sets of objectives fitted with special registering devices (Fig. 23). The

Fig. 22. Set of Gaumont negatives and positives

results given by this process are admirable, all colors, of course, being perfectly rendered and the quality being in every way first class.

An Advantage of the subtractive color process for motion pictures is that the film so produced can be shown in any ordinary machine and this advantage is even greater in the case of motion pictures than in the

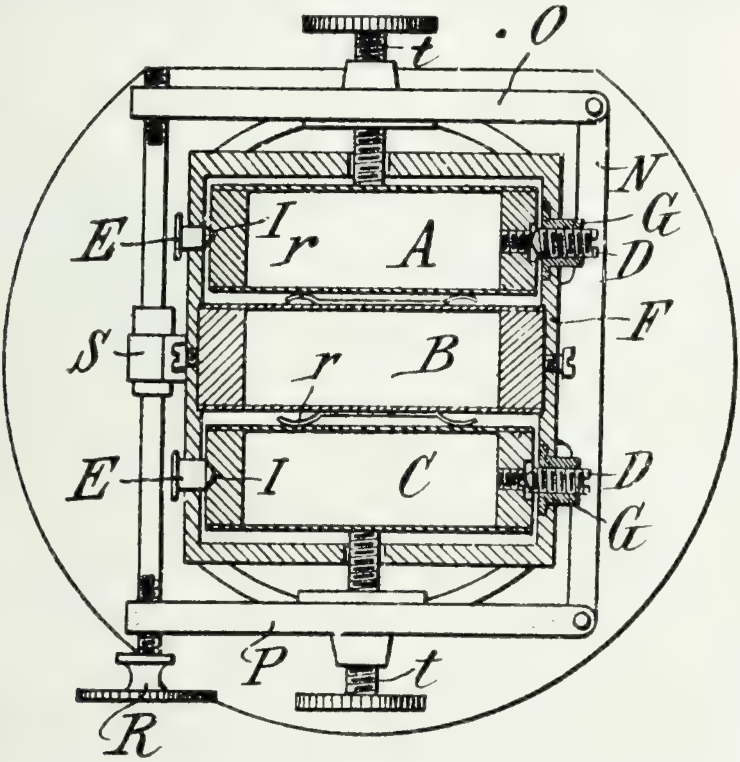


FIG. 23. Diagram of three lenses in Gaumont Camera

case of ordinary lantern slides. The obvious method of making subtractive motion pictures would be to make three negatives, and to superpose the negatives upon each other in printing, recoating the film each time and using a dyed bichromate process or a process in which the silver image is made to mordant the dye and so is transformed into a color image. The recoating and re-registering, however, present very great difficulties in practice and would make the process very costly, and

it appears likely that the subtractive processes of color cinematography will use only two printings; that is to say, they will be chiefly two-color processes, and these two printings may be either in the one emulsion layer, if this proves possible, or in two emulsion layers on opposite sides of double-coated film, a method which appears at the present time to offer considerable advantages in the direction of simplicity.

It is clear that since there are two sides to film, it is

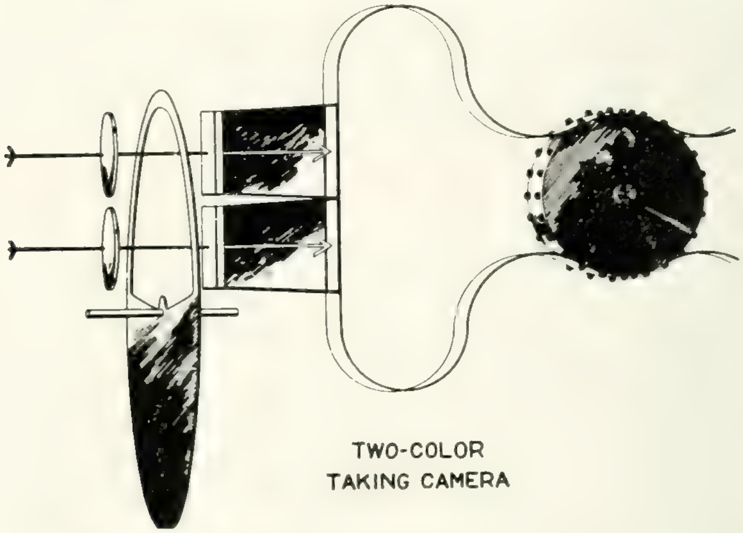


FIG. 24. Diagram showing principle of Two-Color Taking Camera

possible to coat an emulsion on each side of the film and to print the red image on one side and the green on the other. This process has been worked out to a practical end in several ways, some of the color images being produced by the mordanting of a dye upon an image obtained by the conversion of the silver into some suitable substance or by the imbibition of a dye into the gelatine, or by toning by chemical means to colored images.

Capstaff's Process. A typical two-color subtractive process is that worked out by J. G. Capstaff in the Research Laboratory of the Eastman Kodak Company. The silver is used to harden selectively the gelatine

and thus to enable a silver negative to be transformed directly into a dye positive. In order to apply this to motion-picture work, the negatives are taken in a camera in such a way that red and green pictures are taken successively, one below the other (Fig. 24). This may be done as in the Kinemacolor process, using a rotating color filter, or in a camera fitted with some optical beam splitting device enabling two images to be produced from one standpoint, the disadvantage of this being the loss of light involved. From this strip of negative film, a master positive is made, and this is then printed by means of a special projection printer upon opposite sides of double-coated film (Fig. 25). In this projection printer, the red positive is projected onto one side of the film and simultaneously the green picture onto the other, the images being slightly displaced vertically so that they exactly register one on top of the other on opposite sides of the film. The emulsions being exactly the same and the light intensities the same, there is no difficulty in obtaining equal results in the two pictures, and the strip is then developed and fixed for the two pictures, and without further delay is passed into the bleach bath, which bleaches the silver and locally hardens the gelatine where the silver was present. The silver is then fixed out, leaving a clear coated gelatine strip of film bearing the images in the form of hardened gelatine on both sides. The two sides are then dyed by passing through a dyeing machine, the side containing the pictures taken through the red filter being dyed blue-green and that through the green filter, red. On viewing the film so prepared, a two-color subtractive picture is seen, which, being on standard film, can be run in any machine in the same way as black and white.

Factors in Color Cinematography. In considering processes for cinematographic work the following points must be dealt with: (1) Exposure necessary. (2) Quality in the negative. (3) The handling necessary for the production of the positive. (4) The type of projection machine required. (5) The amount of current required for light. (6) Definition. (7) The color rendering obtained.

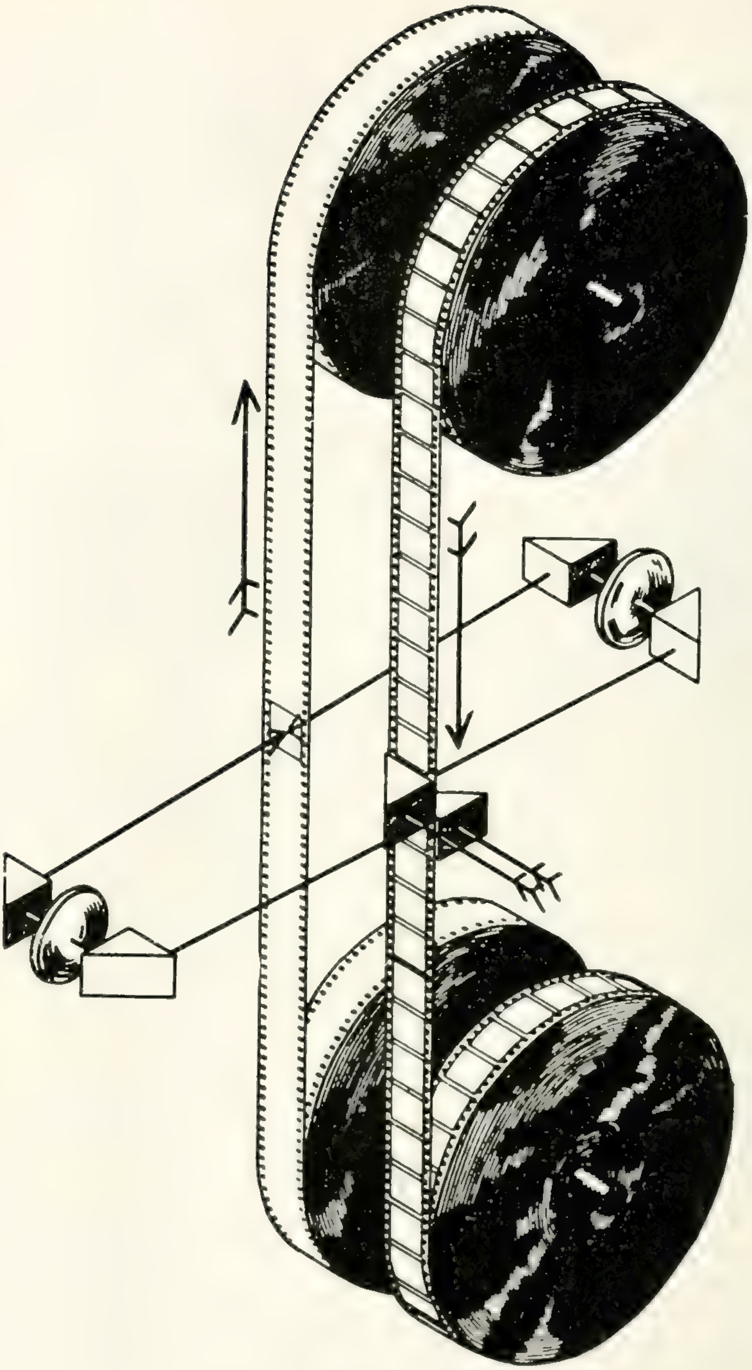


FIG. 25. Two-Color Projection Printer

1. **Exposure Necessary.** In the additive processes the most advantageous position is held by the Gaumont process because in this process the pictures are taken at normal speed, the filters can be made as light as is compatible with color rendering, and the whole aperture of the lens can be utilized. In a number of patented methods of taking the successive pictures, the light from the lens is split up into several parts, so that two or three pictures are taken simultaneously through the one lens. Assuming that any such process is perfect mechanically and optically, the loss of light entailed by using only one lens for several pictures is a very serious objection. In some cases where a complex reflecting system is used, it is probable that the loss of light will be so great that the method will be quite impracticable with any materials at present in sight.

When the pictures are taken successively through a single lens instead of simultaneously through two or three lenses, we have the disadvantage that the exposure must necessarily be shorter because the two pictures must be taken in the same period as that in which the one picture is taken in the other set. Sometimes an attempt is made to lessen this disadvantage by using very light filters, somewhat to the disadvantage of the resulting picture. Such light filters cannot be recommended as they are invariably detrimental to the color rendering.

The Exposure necessary for outdoor work may be worked out as follows: The exposure necessary for the production of a fully exposed picture under conditions of midsummer noonday lighting with an aperture of *f*:3.5, which is the largest aperture generally used for cinematographic work and negative film of the highest speed which can consistently be made, is approximately 1-300th of a second. The best sensitizing which can be obtained at the present time gives an increase of exposure through the red filter of six times. The other filters can be adjusted to the red filter exposure. About 1-50th of a second is therefore the shortest exposure with which we may hope to get fully exposed negatives, so that if we have a camera taking fifteen pictures a second, we should have no difficulty in mak-

ing exposures in full summer sunlight in one-third of the time required for the shift of each picture, thus enabling us to take, for instance, two pictures in that time. It will be seen, however, that there is not very much margin in exposure, and that we cannot expect to take color photographs under other conditions than those of first-rate outdoor lighting.

When we turn to stage work, the conditions are somewhat different, because the amount of light which we can concentrate on the stage is limited mainly by the amount of electricity we are willing to use, though a second limitation must necessarily arise in the inability of the actors to face the light of such powerful stages. It may be reckoned that under the best conditions the light required for color work is twice or three times that required for black-and white motion-picture photography. For color work, naturally, the lamps must give white light, that is, they must be arcs or nitrogen tungsten lamps, the use of mercury vapor lamps being impossible. It may be considered that with suitably arranged stages the taking of dramas by artificial light in color is entirely possible.

2. Quality in the Negative. In most additive and subtractive processes the photographic quality of the resulting picture can theoretically be as good as black and white, and any falling off from this standard is not due to inherent conditions but to insufficient experience and perhaps to some extent to the difficulty in getting sufficient exposure. With the additive processes, it should be possible to get quality exactly corresponding to that obtained in black-and-white photography, but in the subtractive processes the color process does not necessarily reproduce exactly the scale of rendering of the negative, and in the development of a new process a careful investigation of the accuracy with which the process reproduces the scale is necessary.

3. Production of the Positive. The practical making of the positives for projection in the additive processes presents little more difficulty than black-and-white work. More attention to detail is required, and a rather higher standard of regularity of quality must be maintained, but the process does not involve any spe-

cial difficulty. When we turn to the subtractive processes, the handling is, of course, the key to the whole matter. From every other point of view, these processes are the most satisfactory, and the only thing that has kept them back is the intrinsic difficulty of making the positives. A detailed discussion of the difficulties of the subtractive processes and of the methods by which they are overcome would occupy too much space to be possible here.

4. **Projection Machine.** The additive processes require, of course, their own special projector, the Kinemacolor machine having rotary filters which can be thrown out of the way, thus making the machine convertible to a black-and-white projector, while the Gaumont process requires a triple projection machine with registering arrangement which cannot easily be converted into a black-and-white machine. These special projecting machines are the great disadvantage of the additive processes and will probably always restrict their use.

5. **Light Required for Projection.** Both the Gaumont and the Kinemacolor processes involve a considerable loss of light, so that more current has to be used in projection. The absorption of the Kinemacolor filters, which are as light as possible, is such that only two-thirds of the incident light reaches the screen, and for equal brightnesses two and a half times as much current must be used. With the Gaumont process, the matter is somewhat worse, the filters being not only slightly darker than the Kinemacolor filters, but the blue representing the entire loss of one-third of the light, since, while the blue filter contributes to the color of the scene, it adds very little, indeed, to the total brightness.

The subtractive processes, having their highlights represented by clear film, do not require any increase of current whatever, the brightness being the same as for black and white. This is one of the great advantages of the subtractive processes.

6. **Definition.** There seems to be no intrinsic reason why the definition in the additive processes should not be as good as in black and white. In the Kinemacolor

process, at any rate, the definition is as good, but in the Gaumont process the definition may be affected to some extent by slight imperfections in register. The high aperture at which the lenses for these color processes have to be used tends to give a slight degradation of detail compared with the black-and-white processes in which a smaller stop can be employed.

A question of similar nature to definition is that of register between successive pictures. This arises in two different forms, according to whether the pictures are taken simultaneously, as in the Gaumont process, or serially, as in Kinemacolor. If they are taken serially, then a quickly moving object will be in a different position when a red negative is taken, from that which it occupied when the green negative was taken, and it will present on the screen alternate bands of red and green, this defect being apparent as a colored striping of quickly moving objects. When the pictures are taken simultaneously, as in the Gaumont process, then the red picture, being taken from a slightly different standpoint than the green picture, it will not be possible to register both the distance and the near foreground together—a kind of defect which may be called *stereoparallax*. It is partly in order to diminish this that specially narrow pictures are used in the Gaumont process so that the taking lenses can be placed nearer together. In the Gaumont process this *stereoparallax* is diminished to a minimum by registering during projection, so that the principal object is registered, the plane of register being shifted as the subject may require. This defect can, of course, be entirely removed by using one lens for taking the two pictures, a result which can be accomplished in various ways. The disadvantage of this is the loss of light, but it is by no means certain that careful attention to the design of the lens system might not enable a system to be made working at the equivalent of *f* 4 and free from *stereoparallax*.

7. The Color Rendering. Among all processes of color photography, the rendering given by the three-color additive process is supreme. Indeed, under favorable circumstances, the color rendering by this pro-

cess is almost perfect. The subtractive processes, even the best three-color processes, do not give as good results as regards rendering as the additive processes, because no dyes can fulfil the theoretical conditions as correctly as the projection filters can.

When we turn to the two-color process, as has been explained previously, the position of the additive and subtractive processes in regard to color rendering is reversed, and the color rendering obtainable by means of the two-color subtractive process is intermediate between that of a three-color process and that of a two-color additive process.

From this general discussion of the processes of color cinematography, it will be seen that the additive processes, and especially the three-color additive process, while able to give photographic quality and color rendering superior to the subtractive processes, seem to have a somewhat limited field owing to the necessity for the use of a special projecting machine. These are likely to survive for the very best three-color work.

For the wide field of general moving-picture work, it is probable that a two-color subtractive process having the color in the film so that it can be used in any projector without increase of light must prove the most suitable, and that in all probability this process will be one having the two colors on opposite sides of double-coated film.

It will be clear that we are still far from the ideal process, in which the negative is taken upon a single sensitive material without the interposition of separate filters, and from this negative prints are made either in the form of transparencies or upon paper, the prints being permanent, bright, transparent, and containing in themselves a perfect reproduction of the colors of the original, approaching at least in accuracy that obtained in a black-and-white print. No process at present in sight approaches these requirements, but it does not follow that it is impossible to work out such a process, and it may be that at some time in the future we may hope to have color photography available in a form as simple as modern photography in monochrome.

C. E. Kenneth Mees, D.Sc.

In Memoriam

FRANK S. NOBLE

I record with sorrow the death of Frank S. Noble, Vice-President of the Eastman Kodak Company, which took place quite suddenly on the evening of July 5, at his home in Rochester, N. Y.

Few men were more widely known or held in greater affection in the photographic trade, with which he was actively associated for over a quarter of a century. When I first met him, in the now far-away days of collodion and gelatine print-out papers, Frank Noble was blazing the trail with Ilotype paper, just introduced by Kuhn. Later he was associated with the old New Jersey Aristotype Co. and, in the late nineties, with the American Aristotype Co., which eventually brought him into the service of the Eastman Kodak Company. In those days he was a familiar figure at the National Conventions, with Pattison, Cramer, Hammer, Somerville, Croughton, Cossit, Inglis, Taprell, and others now vanished and gone.

After a few years as manager of the Chicago branch of the Eastman Kodak Company, Mr. Noble was called to Rochester to take the duties of assistant treasurer of the company, of which he was later made Vice-President. During the twenty years thus spent in Rochester, he took an active part in the social and civic life of the city and leaves there a host of friends to mourn his passing.

When America entered the War Mr. Noble was appointed Director of Production of Munitions for New York State outside the New York City area. To this patriotic task he gave his untiring skill and energy so unsparingly that his health was undermined, and he was ill for some weeks after the completion of his service. But he returned to his duties with the Eastman Kodak Company and all seemed well. The terrific strain of his war work, however, had told upon his heart, and his unlooked-for end numbers him with those who gave their lives in the field of war for our country.

He leaves behind him the inspiring memory of an American of the finest type, a good citizen, and a loyal friend.

The Year's Exhibitions

The revival in pictorial photography which came at the end of the Great War had its culmination during the twelve months just ended, August 1920–July 1921, in a procession of notable exhibitions surpassing in quality of achievement and variety of interest all pre-war records for a like period and, in the nature of things, hardly likely to be equaled for some years to come.

This wonderful year began with three international exhibitions held at Copenhagen, Antwerp, and Toronto during August and September, 1920. Thanks to the efforts of the Pictorial Photographers (New York), a fairly representative collection of American work was shown at Copenhagen. The Antwerp exhibition comprised chiefly examples of Belgian, Dutch, French, and British work. At Toronto, where professional as well as amateur exhibits were invited, a respectable amount of American work was accepted and hung.

The brilliant shows of the Royal Photographic Society and Salon followed, at London, in September and October. Of the thousands of prints sent to these shows, over 500 exhibits (including technical and scientific work) were hung at the Royal, and about 400 prints at the Salon. These exhibitions brought out so much good American work that it was necessary to arrange for overflow exhibitions of American work exclusively, which were held after the close of the R. P. S. exhibition and Salon, and attracted remarkably large attendances.

The Los Angeles Salon, held in that city in January was noteworthy for the vigorous infusion of new blood evidenced in the 300 prints upon its walls, many of them by workers hitherto unknown to exhibition catalogues. Pictorially considered, the exhibits showed a growing discrimination in the arrangement and treatment of the subject, with a pleasing absence of freak and bizarre effects. Over a thousand prints were sub-

mitted to the judges, and it is reported that more than 5,000 persons visited the Salon in a single day, which speaks well for California's interest in the pictorial possibilities of photography.

The Pittsburgh Salon, held in the beautiful galleries of the Carnegie Institute of that city during March, thoroughly sustained the reputation of this annual exhibition as the premier event of its class in this country. About 370 prints from American and foreign pictorialists were accepted; these touched the highest standard of quality yet reached, with the largest sale of prints thus far recorded. More than 1,200 prints were submitted, the small number hung expressing the determination of the Salon authorities to make acceptance at this exhibition a mark of distinguished merit. Among the novelties were four very small carbon prints of exquisite workmanship, sent by an English amateur. Another departure was seen in the large number of prints in pearly grey tones of high key, a pleasing relief from the unbroken masses of sombre black and brown characteristic of the photographic exhibitions of the past few years. In printing processes used the Salon showed a growing appreciation of silver chloride (development) papers by pictorialists, who have hitherto affected to despise this medium. The public attendance at the Salon exceeded that of past years, and it was observed that many visitors came in groups from far distant points.

The Pictorial Photographers of America, in addition to the publication of their annual "Pictorial Photography in America, 1921," published last December, organized a collective exhibit of the work of members and routed the collection, through the American Federation of Fine Arts, among the principal cities of the Union during the year, these efforts taking the place of a single, local exhibition.

Two National Professional Exhibitions of the year deserve mention. The first was that of the Professional Photographers' Association of Great Britain, held at London in April. The second was the American National Convention Exhibit, at Buffalo, in July. Almost wholly confined to photographic portraiture from the

leading professional studios of Britain and America, these two exhibitions were thoroughly representative of the best commercial portraiture of today. Speaking generally, the work evidenced a high degree of technical skill in lighting and chemical effects, with a decided tendency towards the introduction of decorative design and pictorial effect. This is praiseworthy, provided that the vital element of likeness is not obscured or lost in the process, as was too often apparent. Judging by a special section of the Buffalo exhibition, devoted to the work of English and German photographers of acknowledged reputation, our American photographers are well abreast in achievement.

During the year three general exhibitions, national in scope and general in character, were promoted by large business firms in Philadelphia, Seattle, and Kansas City. These attracted a considerable volume of pictorial work of excellent quality from all parts of the country and were largely attended by the general public. Of the many smaller general exhibitions, given during the year by camera clubs and societies, it is impossible to write in detail. Mention may be made, however, of the interesting exhibitions held at Detroit, Portland, Boston, and Memphis. All these evidenced a lively and widespread interest and, collectively, accomplished splendid results in demonstrating the pleasures of photography.

One-Man Exhibitions. It remains to deal with some of the innumerable one-man exhibitions which were, perhaps, the most significant feature of the year.

The Stieglitz Exhibition. Among these one-man shows the outstanding event of the year was, undoubtedly, the Exhibition of Photography by Alfred Stieglitz, held at the Anderson Galleries, New York, in February. This comprised 145 prints in platinum and palladium, dating from 1886 to 1921, and thus uncovering the photographic development of Stieglitz during almost forty years. Of these 145 prints, less than a score represented his early work, prior to 1908, with which the public is familiar through reproductions. The remaining 128 prints had never before been publicly shown, and the chief interest of the exhibition centered around

78 of these 128 prints, the work of the years 1918–1921. In every instance the exhibits were put forward as examples of "pure" or "straight" photography, i. e. untouched prints from untouched negatives.

In order to grasp the significance of this exhibition, it is necessary to recall the place and work of Stieglitz in the development of modern photography—his inauguration and leadership of the American pictorial movement, his strenuous fight for the recognition of photography as a medium of expression among the fine arts, the remarkable demonstration of its possibilities along this line in his "Camera Work" and other publications, and the splendid work accomplished by the Little Galleries of the Photo-Secession familiarly known as "291"—all in the face of a torrent of ridicule and opposition. All these activities, it will be remembered, he abandoned in 1917–18, thereafter isolating himself in impenetrable silence and obscurity. His work, however, could not be forgotten and there was no end of speculation: Where is Stieglitz? What of his work? *Cui bono?* and the like.

At once his answer and challenge; the apocalypse of a personality unique in photographic annals, this exhibition at the Anderson Galleries aroused more comment than any similar event since photography began, and deservedly, in that it was an exhibition of photography such as the world had never before seen. A demonstration of what Hurter and Driffield years ago asserted to be "the most valuable distinction of photography, i. e. its capacity to truthfully represent natural objects, both as regards delineation and light and shade." A revelation of the ultimate achievement of photography, controlled by the eye and hand of genius and utterly devoid of trick, device, or subterfuge!

The exhibition was visited by over 8,000 persons. Many of these were men and women prominent in the art life of New York, painters and sculptors, critics and craftsmen, photographers, scribes and pharisees. Some went again and again, spending hours in the silent observation of this strange show, seemingly unable to satisfy their appreciation of its significance. The unsophisticated looked and repeated the one word "Won-

derful" over and over. They seemed to find no difficulty in understanding and went right to the heart of what they saw in that direct and forceful comment. The sophisticated majority, pictorialists, professional photographers and serious amateurs, were plainly shocked, and either shook their heads in disapproval or raged in hot fury against the whole display. To these the characteristic "Statement" prefacing the catalogue of prints, the "continuous performance" of Stieglitz in person during the exhibition, and the character of some of the subjects displayed on the walls, constituted so many stumbling blocks of offence which blinded them to the real merit of the work on display. Then there were the enthusiasts. Stieglitz tells me that he turned down proposals for ten sittings for portraits at $1,000 each; that he was offered and refused $1,500 for a single print. Two prints were sold at $500 each, and there was an offer to finance a tour of the exhibition, with lectures by Stieglitz, through the United States and abroad.

The photographic press noticed the exhibition in scant paragraphs of hesitant praise, apparently speaking from hearsay or newspaper report. The sternly practical "B. J." usually so dependable for the accuracy of its appraisals, devoted a column of Tilneyesque ridicule in three languages to the personal "Statement" prefacing the catalogue and let it go at that. Under the initials "Q. R.," a well-known art critic and former editor of the London *Academy* gave the exhibition two columns of unstinted praise in the *Christian Science Monitor* of February 21. *The Nation* gave it an illuminating page in its issue for February 16. Robert McBride gave his impressions in a three-column review in *The New York Herald* of February 13. Paul Strand issued a privately printed and personal defence of the exhibition headed "Alfred Stieglitz and a Machine." In *The Dial* for April, Paul Rosenfeld devoted thirteen pages to an endeavor to express his opinion of Stieglitz and his work. Guido Bruno, in his *Review of Two Worlds* (June) spluttered incoherently through a couple of pages, making the queerest misstatements and using, or misusing, the King's English in revolutionary fashion

—and so on. Never was there such a hubbub about a one-man show.

What sort of photographs were these prints, which caused so much commotion? Just plain, straightforward photographs. But such photographs! Different from the photographs usually seen at the exhibitions? Yes. How different? There's the rub. If you could see them for yourself, you would at once appreciate their difference. One might venture the comparison that in the average exhibition print we have beauty, design, or tonal scheme deliberately set forth, with the subject as motive or material merely, the subject as the photographer saw it or felt it, an interpretation, a phase; whereas, in the Stieglitz prints you have the subject itself, in its own substance or personality, as revealed by the natural play of light and shade about it, without disguise or attempt at interpretation, simply set forth with perfect technique—and so on, multiplying words. There were portraits, some of them of men whom I knew fairly well. Sometimes it was a single print, at other times several prints side by side giving different aspects of the subject but grouped as "one Portrait." Well, they were just portraits of those men, compellingly intimate, betrayals (if I may so use the word) of personality, satisfying in likeness, convincing in characterization, instinct with the illusion of life. They gave one the impression of being in the presence of the men whom they portrayed. They offered no hint of the photographer or his mannerisms, showed no effort at interpretation or artificiality of effect; there were no tricks of lens or lighting. I cannot describe them better or more completely than as plain, straightforward photographs; not the photographs of that sort which the beginner, by happy accident, sometimes produces, truthfully representing all the external details of the subject by a combination of perfect lighting, correct exposure and correct development in negative and print; but all this plus the nature, substance or personality of the subject, the vital interest, truth and life of the subject, resulting from an absolute mastery of the mechanics and technique of the photographic process. Contrast such photographs with the average exhibition

print, in which the representation is confused by the introduction of innumerable alien elements (interpretation, the personality of the photographer, peculiarities of printing paper and methods, errors in technique, etc.) and you may sense the interest of the Stieglitz exhibition.

Technically, the photographs were simply straightforward, unmanipulated prints from untouched negatives on double-coated plates, made with a view camera and anastigmat lens of generous focal length, generally used at *f*/45 or smaller. They were neither disagreeably sharp nor disagreeably soft in definition; there was no confusion in form; the planes had their proper relation and separation. They made me want to forget all the photographs I had seen before, and I have been impatient in the face of all the photographs I have seen since, so perfect were these prints in their technique, so satisfying in those subtler qualities which constitute what we commonly call "works of art."

Camera Club of New York. The photographers of New York and vicinity, whether pictorial or plain, are greatly indebted to Mr. Floyd Vail and his associates of the Camera Club of New York for their splendid work in bringing to America an unique series of "one-man" exhibitions presenting the cream of the British pictorial photography of the last ten years or so. A few "one-man" shows by American pictorialists were interpolated during the season to break the monotony of so much good British work, so to speak. Among these latter the exhibitions of large bromoil and gum-prints by Dr. A. D. Chaffee and William Gordon Shields, the ambitious but excellent marines of Bertrand H. Wentworth, the soul portraits of Rabinovitch and the large artatones of Karl Tausig deserve special mention.

Alexander Keighley. Of the British shows, the exhibition of Alexander Keighley's work was perhaps the most impressive in its extraordinary interest. It consisted of some fifty-odd large prints in carbon, generally of sylvan or pastoral scenes, with here and there an outdoor figure, scene or group. Superb in technique, their pictorial or decorative quality was always the chief interest. Mr. Keighley is admirably normal in his

outlook on life and art, seeing the loveliness of nature with an understanding eye and revealing its moods and nuances with exquisite delicacy and restraint. One felt that the pictures were composed on the ground-glass, in the field, and not pieced together in the printing or enlarging room, by a method as straightforward as it was simple and sincere. The beautiful atmospheric effects had all the subtlety and indefinable charm of the real thing; the planes had their true separation and merging; the distances were actual distances; but always without the blurring of form, fogging of detail and messing up of the definition which so commonly betrays the unskillful use of special lenses or printing media. I cannot recall an exhibition of photographs within the past few years which gave me so much pleasure. It brought more visitors to the Club than any other exhibition of the year, and the critics of the metropolitan press were unanimous in its praise.

Fred Judge and Bertram Cox. The wonderful range of effects possible by means of the oil and bromoil-transfer methods of printing was comprehensively demonstrated in the exhibitions of the work of these two English photographers, held at the Camera Club during February and April. Our American workers in these processes have shown us the capacity of oil and bromoil for the production of large prints with strong, broad masses of rich tone and force. In the prints of Judge and Cox it was seen that these methods are equally adapted for the making of small prints in which delicacy of detail and softness may be combined in a manner wholly admirable and satisfying. The exhibitions aroused the keenest interest and will undoubtedly lead to a wider appreciation of bromoil methods among American workers.

The Mortimer Exhibition. Perhaps the most spectacular and certainly the most popular of these Camera Club one-man shows was the last of the season, an exhibition of sixty large sea pieces by F. J. Mortimer, of London, whose work and methods were so well described and illustrated in THE PHOTO-MINIATURE No. 71, August, 1905.

Mr. Mortimer is deservedly recognized as the fore-

most living photographer of the sea and his pictures abundantly attest his skill and mastery in this difficult field of camera work. Among the prints on display, generally 11 x 14 inches or larger, I found at least a score in which the ever-changing moods and marvels of the sea were depicted with an artistry surpassing anything I have seen in the treatment of such subjects by masters in painting, which is no mean praise, recalling the painter's advantage of color nuances and the like. The prints were on bromide paper, with a few bromoils, and in all (which is worth noting) the pictorial or decorative charm evident in the treatment of the subject was well supported by a mature and splendid technique.

Edward R. Dickson, whose "Platinum Print" will be pleasantly remembered by the few, gave an exhibition of his recent work at the School of Design and Liberal Arts, New York, in February, and again, at the Touchstone Galleries in April. The collection comprised about sixty prints, 8 x 10, in platinum and bromide; straight prints from negatives free from any retouching, dodging or manipulation, simply arranged on the walls in four groups, without the usual broad expanse of white cardboard mount which bolsters the exhibition print of today.

Mr. Dickson is an ardent believer in the design or pattern theory of picture making, and his prints, chiefly interpretations of the dance, the unappreciated beauty of New York streets and buildings, with a few portraits, cleverly exemplified the possibilities of this theory. The dance pictures, instinct with life and rhythmic movement and free from the crudities of arrested motion, aërial gymnastic and absurd postures so often seen in this sort of picture making, were especially pleasing in design and decorative effect. Many of his New York scenes have been reproduced in the *New York Evening Post* during the summer. Altogether it was an enjoyable and satisfying show, thoroughly establishing Dickson's reputation as "one who visions beauty in the commonplaces of experience."

The Brooklyn Institute of Arts and Sciences. (Department of Photography). Under the enthusiastic direction of Mr. William Alcock, this group has made

an enviable record in current pictorial activities, all the big exhibitions, here and abroad, having accepted a generous quota of the work of its members. Many of the pictures thus honored, with others of equal interest and quality, were shown at the annual exhibition of members' work. This was held at the Institute in May and, by invitation, repeated at the rooms of the New York Camera Club. A feature of this exhibition was the unusual variety of printing processes used by exhibitors, doubtless the result of the intensive study of pictorial printing methods pursued by the group during the year, which included many demonstrations and lectures by exhibitors, explaining their methods.

Charles H. Davis. Among the one-man exhibitions given at the Institute during the year, that devoted to the work of Mr. Charles H. Davis attracted much attention. This was wholly made up of professional work by this versatile photographer. The accompanying lecture on "The Composition of the Figure," in which Mr. Davis illustrated his theories by reproductions from modern masters of painting, was largely attended and enhanced the interest of the prints shown on the walls. These latter comprised studio portraits by daylight and artificial light; home and garden portraiture; decorative figure work for illustration and advertising purposes; pastoral compositions reminiscent of the work of the late H. P. Robinson; a few groups of outdoor dances; with half a dozen landscapes of rare charm and feeling.

Mr. Davis is a past master in the portraiture of women and displays much skill in the treatment of the figure, the hands, lines and their terminations. The chief interest of his show centered in this class of work; but the standard of quality maintained through all the exhibits deservedly place him among the foremost professional workers of today. The exhibition was repeated at the Hoboken (N. J.) Public Library in March.

The Chicago Camera Club continued the notable series of one-man exhibitions inaugurated last year with signal success. Among the men whose work was shown I note the names of Louis Fleckenstein (Los Angeles), J. G. Sarvent (Kansas City), B. F. Langland (Milwaukee), John Wallace Gillies (New York), Henry

Heichheim (Boston), and C. W. Christiansen (Chicago). The annual exhibition of members' work, held in April, brought out much good work and drew an unusually large attendance.

A small exhibition of selected prints by prominent pictorialists, held at the studio of Alfred Cohn and August Krug, in Brooklyn, during April, deserves special mention. Another interesting show was that held at the City Club of New York in October, when Mr. Ben J. Lubschez exhibited forty examples of his recent work. Of these prints, generally bromide enlargements about 11 x 14, S. J. Kaufman of the New York *Globe* said: "Some of the best things I have seen done with the camera."

In April, Mr. T. O'Conor Sloane, Jr., showed a small but choice collection of his pigment portraits at the Gallery of the Hotel des Artistes, New York. Among these prints were a few of the cleverest multi-color gums I have yet seen.

Bertrand H. Wentworth had an interesting one-man show, in April, at the rooms of the Society of Arts and Crafts, Boston, which was followed by an exhibition of the work of Herbert B. Turner and Raymond E. Hanson, all worthy craftsmen.

In April, also, Travers Sweatman, K. C., of Winnipeg, gave an exhibition of seventy examples of his recent work at the rooms of the Art Bureau in that city. These included a series of remarkable "pinhole" photographs of the new Parliament Buildings which were much admired.

E. O. Hoppé. I must not end these notes without a brief mention of one of the most interesting shows of this crowded year, the Exhibition of Photographic Prints by Mr. E. O. Hoppé, of London, at the Belmaison Galleries, New York, in March. This exhibition, which really deserves extended notice, comprised about 150 prints, including half a dozen striking "gums" in Bartolozzi red; a few decidedly clever "Studies in Rhythm" fresh and original in treatment; many unconventional portraits of men and women in public life here and abroad, showing masterly handling in pose and arrangement; a collection of "London Types," and a little

group of dream pictures showing the streets of London veiled in mist—full of charm. Almost all the prints were of large size, 14 x 18 inches, mounted on rough Japanese tissue with a dark mat surrounding the print, obtained by laying a black form under the tissue mount. It was a most enjoyable show, abundantly sustaining Hoppé's reputation as a skillful and discerning photographer, able to use the camera and process as tools and control them to worthy ends.

Books and Prints

Geometrical Investigation of the Formation of Images in Optical Instruments. Edited by M. von Rohr. Translated by R. Kanthack. 612 pages, 1920. London: His Majesty's Stationery Office.

This is the second of the projected series of translations of standard optical treatises of foreign origin, published by the (British) Department of Scientific and Industrial Research for the guidance and help of the British Optical Industry. The original text forms Vol. I of Von Rohr's classical work: "The Theory of Optical Instruments." Mr. Kanthack's translation, in which he had the assistance of eminent specialists in this field, is spoken of by those competent to judge as accurate and trustworthy.

Photographic Abstracts is the title of a new quarterly journal, issued by the Scientific and Technical Group of the Royal Photographic Society, London, at 10 per year. Single numbers 2 6 each postfree. As its title indicates, this is intended to give the photographer a series of abstracts of the more important papers on the technical side of photography published in the photographic, technical and scientific press of Europe and America. The first two issues received are excellent in arrangement and content.

SWEET SIXTEEN

Illustrating the use of the soft-focus lens in pictorial portraiture.

LOUISE BELL-RAU

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Soft-Focus Effects in Photography

The question of diffused or soft-focus effects in photography has agitated this little world of ours for more than a quarter of a century. The time is ripe, therefore, for a concise statement of the whole matter, with a detailed consideration of the soft-focus lens about which this agitation centers. For such an adventure no setting could be imagined more appropriate than the pages of THE PHOTO-MINIATURE, wherein so many a jeweled tale has been told, coruscant with life and interest. Into these pages, then, I have gathered from the accumulated experience of the years, a compend of information from which the reader can form his own opinion on the subject, thus settling the question for himself—and arriving at the end of the adventure.

Let us recall, in the beginning, that photography has always been properly described as an art-science. It has two sides: an art side and a scientific side, generally put the other way about, as technical and pictorial photography. Speaking from the scientific or technical side, Hurter and Driffield tell us that "the most valuable distinction of photography is its capacity to truthfully represent natural objects, both as regards delineation and light and shade." From the art side, at the very birth of photography, the painter Arago declared: "Painting is doomed; photography is mightier than the brush or pencil"—or words to that effect. Since which

time photography has abundantly justified its claim to a place among the Arts as a medium of pictorial expression.

Herein lies the heart of the soft-focus question. All photography is concerned with the representation of things, with delineation and light and shade. In many uses this means accuracy in the reproduction of form and detail, crisp definition of detail, accurate representation of form as it is in fact rather than as the eyes see it. Those who so use photography, whatever their purpose, need not bother themselves about soft-focus lenses or the question of diffusion effects. The question and the lens concern the other side of photography, as a means of pictorial expression. Looked at from this side the manner of delineating objects, the definition and structural representation of the lines and masses composing the subject, assume a totally different aspect and have a quite different interest. It is only to those following photography as a medium of pictorial expression, therefore, that the question of diffused focus effects and the soft-focus lens have any importance.

But here they are of vital importance. In picture making, by photography or any other art, imagination is the creative force. And what is imagination but the faculty which calls forth or forms images, from things visible and invisible, clothing dry facts with the vesture of dreams. Art, as someone has said, is nature seen through a temperament. The scientific process or tool reproduces a thing as it is, in fact gives a replica of the original. Art gives us the thing as a man sees it or, rather, what he sees in the thing envisioned by his eyes *plus* that indefinable something we call temperament or feeling, springing from his appreciation of beauty, order, or special interest.

As to tools, such as lenses, there is room and place in photography for many varieties to meet the requirements of different methods of expression. It is so everywhere. The railroad crossing sign uses sharply defined words, "Stop, Look, Listen;" the lover's message to his beloved is in soft-focus, "O stars that fade in amber skies," etc. In music we have the *largo*, *adagio*, *staccato* and so on. So, in days now past and

other times, some men took their liquor "straight," while others took it as the world takes a pill, "with water."

A Rebellion. From the beginning in photography there were always those who rebelled against the hard and wiry definition of the lens. When, in the anastigmat, this capacity for definition reached perfection, revolution broke loose. The revolutionists contended that the rigid, wiry definition and lack of breadth of planes which marked the performance of the anastigmat were utterly out of place in portraiture and pictorial photography, wherein the soft outlines, atmospheric depth and well-separated planes of nature are of supreme importance. In this divine discontent with the super-perfection of the anastigmat the soft-focus lens was born.

Pioneers. As early as 1893, Dr. P. H. Emerson, whose "Naturalistic Photography" created such a *furore* on its publication in 1895, exhibited at the London Salon a "Portrait of a Lady" described as taken with the then new telephoto lens of Dallmeyer. This was, I believe, the first portrait publicly shown as made with this type of lens. Among those who were vividly impressed with the unusual qualities of this portrait was J. S. Bergheim, a painter of repute and an enthusiastic amateur in photography. His interest led him to experiment, then to conferences with T. R. Dallmeyer, with the result that Dallmeyer, in 1896, introduced the Dallmeyer-Bergheim lens—the first and original soft-focus lens.

The Soft-Focus Movement which grew out of this small beginning quickly spread from England, through France and other Continental countries, eventually reaching America about twenty years ago. Here and abroad it met with considerable opposition, based in part upon the extravagant claims made by soft-focus workers and, for the other part, upon the peculiar character (rottenness was the word commonly used) of their early work. Be this as it may the idea has steadily grown in favor in all countries, so that more than 50 per cent of the work seen at to-day's photographic exhibitions is of the "soft-focus" sort. Similarly, in

professional portraiture everywhere, the hard and sharply cut definition of a few years ago has largely disappeared.

The Soft-Focus Lens, especially in America, has been developed, modified and "improved," as the simplest and surest way of securing the most desirable diffusion effects. Today almost every lens manufacturer of repute is offering a special lens of this type, while there are at least half a dozen devices offered as efficient substitutes for such lenses.

The Appeal of the Soft-Focus Picture, as made by prominent pictorialists who openly rely upon the soft-focus lens in their work, has led to the belief that the possession of such a lens is the key to successful picture making, a sort of royal road into Art. This in turn has so extended the popularity of the soft-focus lens that its widespread use is being spoken of as "a craze," a disease or species of madness, or certainly an evil tendency to be restrained. Excess, in any direction, is, of course, lamentable. But if in this case it means a wider and deeper appreciation, in the end, of the principles underlying the value and proper use of diffusion effects in photography, the world may be all the better for the touch of madness.

First, however, we must put method in the madness. This means using diffusion effects with malice aforethought, *i. e.* knowing our tools and how to use them intelligently. With which thought let us look to such wisdom as may be found in the pages following.

EDITOR.

Diffusion with Soft-Focus Lenses

In any discussion of lenses of the soft-focus type it is necessary to introduce, at the outset, a little textbook knowledge of the photographic lens of standard type, in order to provide a known basis for comparison and to avoid otherwise inevitable future explanations.

The Picture-Image. We are here concerned with the delineation of form in the representation of objects and, in a more intimate way, with the definition of the picture-image given by the lens. How does the lens form the picture-image? Let us consider all visible objects as bodies whose surfaces are made up of an infinite number of luminous points, with each point reflecting light in every direction by means of what we call light rays. The function of the photographic lens is to bend or refract the image-bearing rays reaching it from an object, so as to bring them together and re-form them as points in a plane behind the lens (*e. g.* on the focusing screen or sensitive film), thus forming there a picture image of the object before the lens, each point in this image being a counterpart of a corresponding luminous point in the object.

Resolving Power. The ability of a lens to so bring the rays reflected by luminous points in an object to points again is spoken of as the resolving power of the lens, *i. e.* its capacity to give a brilliant image of the utmost sharpness or fineness of definition. It depends upon the elimination of the various aberrations or errors inherent in all lenses and is the measure of the excellence of their correction.

The Disc of Confusion. For practical reasons, however, we will here consider the picture-image as made up of very small discs of light instead of sharp points of light. The disc is called "the circle of confusion" and its diameter determines the sharpness or otherwise of the definition of the image. Thus, an anastigmat will resolve a hypothetical luminous point into a circle of confusion not exceeding 1-500th of an inch in diameter. This means a critically defined image, desirable in the case of small negatives intended for after-enlargement. A rectilinear lens, in which the aberrations

are less completely eliminated, will resolve the same luminous point into a circle of confusion of about 1-100th of an inch diameter. This is the generally accepted limit of "confusion" or indistinctness of definition permissible, dividing sharply defined from soft or blurred images. In the case of the anastigmat this critical definition covers the whole field, *i. e.* extends from the center to the extreme edges of the plate used, even at the largest aperture or diaphragm of the lens. In the rectilinear, used at its largest aperture, it covers only the center of the field and is "improved" or extended over a larger area by the use of smaller diaphragms or "stopping down." The soft-focus lens, on the other hand, is deliberately designed or left uncorrected to give an image made up of much larger circles of confusion, *i. e.* blunt or rounded discs instead of sharp points of light. Hence photographs made with them are not sharply defined and distinct in detail, but diffused, soft or blurred in definition, the degree of diffusion being, in some but not all lenses of this type, controllable by the use of diaphragms.

Comparisons. The dominant characteristic of the soft-focus lens is that it gives diffused or softly defined images at large apertures (speed), the degree of diffusion, with some, varying in the different planes in the subject and being controllable (differential focusing), this practically resulting in marked depth and roundness of delineation (relief and breadth of planes); whereas the perfected modern lens, *e. g.* the anastigmat, is corrected to give a sharply defined image in one plane (flat field) at large apertures (speed), while the portrait lens is designed to give sharp definition within a limited field (curvature) at large apertures (speed). All three types have speed or "intensity" as the common factor of their usefulness, the difference being almost wholly in the manner of their delineation of form. As to preference in this, it is wholly a matter of personal taste and the purpose in view. Each type has its own place and usefulness.

Pro and Con. The hot discussion which has for so long raged around and about the soft-focus lens and its use is based upon prejudice and misunderstanding

THE CHINESE PERIOD

An illustration of the value of the soft-focus lens in the rendition of draperies and fabrics.

CARLE SEMON

and will not persist. The prejudice is in some measure justified by the lack of any desirable quality in much of the work thus far produced with lenses of this type, resulting directly from their ignorant misuse. The misunderstanding arises in the narrow view that the only good photograph is one which tells the whole story in all its details, leaving nothing to the imagination but faithfully reproducing every hair on the dog, every line and pimple on the face, and every twig and leaf on the tree. In short, it amounts to this, that in the development of photographic optics for the production of lenses capable of combining speed with sharp definition over a large field (so desirable in many branches of photographic work), the opticians went too far from the viewpoint of the artist or pictorial worker, who thereupon revolted from the hard, mechanically precise and map-like delineation of form given by the perfectly corrected lenses of modern type and, going back to the simpler and only partially corrected lenses of earlier days, has developed this earlier type, so that it now gives him the quality of definition he desires with all the speed or rapidity required for its use in the limited field of its application.

A "Pinhole" used instead of a lens will also delineate form and so can form picture-images in the camera. The two monographs (Nos. 27 and 70) in this series, wherein the pictorial possibilities of the needle-hole are interestingly set forth, are well worth a new perusal. But in practice the use of the pinhole is attended with severe limitations.

With the pinhole there is no refraction or bending of the light rays, which travel instead in a straight line from their starting-place on the object before the camera, through the pinhole to their destination on the focusing screen or sensitive plate. The degree of resolution or fineness of definition in the picture image depends on the size of the pinhole used and, even with the smallest and finest pinhole, does not approach the resolving power of a lens. Thus, in the use of a pinhole, the luminous points in the object are not re-formed as points in the picture-image, but are represented by circles of light or, better, circles of confusion the di-

ameter of which approximates that of the pinhole, *e. g.* the circle of confusion with the commonly used No. 10 needle-hole is 1-50th of an inch. The result is an image equally "fuzzy" or confused in detail in all its parts by the overlapping of these circles. Furthermore, the smallness of the pinhole calls for extremely long exposures, *e. g.* about sixty times that required by a lens at F:8. The diffusion effects given by the soft-focus lens, on the other hand, can be varied in the different planes of the subject, with a more desirable firmness of drawing when emphasis is needed, and are obtained with lens apertures approximating those of the most rapid anastigmats, thus permitting of very short exposures.

Other Devices. Apart from the use of the "pinhole" there are many other ways of producing diffused focus effects in photography. Of these I may mention the use of diffusion discs, fine mesh screens and gratings, either on the lens or attached to the diaphragm system of lenses of standard type, and the modifying of the resolving or defining ability of such lenses by means of diffusion adjustments or movements, chiefly designed to introduce spherical aberration, in the making of negatives or the use of the lens in enlarging. There is also the use of transparent or fine-mesh screens of various materials interposed between the negative or lens and the printing paper in making prints or enlargements. Some of these possess real merit and will give pleasing results, but to speak of them here would involve us in too lengthy a digression and they are dealt with elsewhere in these pages. We return, therefore, to our consideration of the soft-focus lens proper.

With this knowledge of the delineation of form, of the way in which the photographic lens forms the picture-image, and of the factors which control the definition of images, we can examine more closely just what is meant by diffusion in a photograph—the crux of the soft-focus question. As a beginning I have prepared three examples of diffusion, which are placed side by side for comparison in Fig. 1.

Different Diffusion Effects. In this diagram, Fig. 1, (A) shows a print from a negative made with a rapid

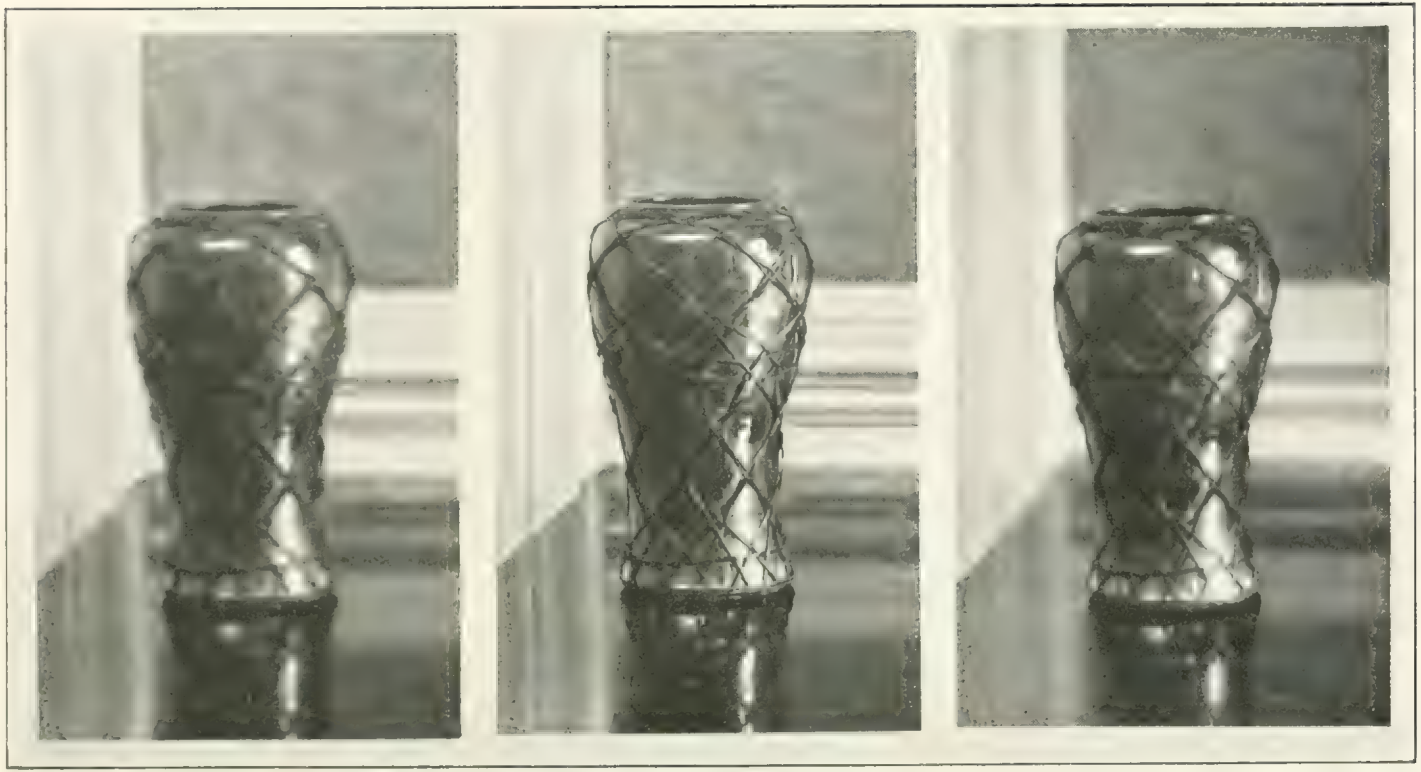


Fig. 1. Three Examples of Diffusion. See page 157

(*b*) Sharp-Lens Negative printed through glass. (*a*) A Sharp-Lens Negative (*c*) Soft-focus Negative 12-in. Struss at F:5.5

rectilinear lens, and represents a point in the object as a point in the photograph. This picture is placed in the center. On the left (B) is a print from the same negative, but the definition of the image has been diffused by the interposition of a sheet of glass between the printing paper and the negative. This diffused image many do not find agreeable, but it closely approximates the quality of image yielded by a pinhole, if the negative is fairly sharp throughout. The third print (C), on the right, is made from the same point with a soft-focus lens of approximately the same focal length, used at full opening, (12-inch Struss at F:5.5) and shows the quality of definition which can be expected from a lens of this type.

The complaint is often made that one is unable to focus a given pictorial lens sharply at full aperture. The answer to this is that if sharply defined images are wanted, the wrong lens has been used: an anastigmat or rapid rectilinear should have been the choice. Soft-focus images should never be sharp, but the form should always be definite in drawing or delineation.

The correct use of such a lens is not a matter of formula, like the compounding of a developer, and is certainly not a hit-or-miss procedure as so many seem to make of it. The aim of the photographer who uses the soft-focus lens should be to produce an image of an agreeable softness. This sounds rather easy, but the joker is in the last two words. Let us try to define "agreeable softness," which we can do negatively very nicely:

"Agreeable Softness" Defined. (1) It is not sharpness. (2) It is not sharpness modified by a spreading of the light parts into adjacent middle tones or shadows. (3) It is not misty, flat rendition. (4) It is not outlineless, textureless rendition. (5) But, affirmatively, it *is* a quality of image, firm yet soft, with a full scale of values and no loss of texture: there should be no halo apparent.

The capacity to render an image which will meet these requirements is inherent in every soft-focus lens. Those obtainable differ only in construction and in amount of diffusion afforded at full aperture. The

claim is made that pictorial lenses have greater depth of field than corrected objectives, on account of the absence of a plane of critical focus. This is true only in so far as it is recognized that there is a true soft-focus quality of image, and that it is just as possible for a pictorial lens image to be out of focus as an anastigmat lens image. (See Fig. 2.) When an objective of the soft-focus type is correctly focused, however, there results a print in which all the planes are pleasingly rendered: as they recede in a landscape, for instance, they are enveloped in light. There is no distinct focal plane or field, as when an anastigmat is used. The definition seems to be distributed over the entire photograph. This atmospheric effect is more to be desired than softness of outline in the picture, still the two seem to go together. The more diffused, up to a certain limit, the picture is made, the more atmosphere it is likely to have. Regression of planes, so important in creating an illusion of relief, is therefore rendered easy of correct accomplishment by the use of the soft-focus lens.

Using Large Apertures. Opinions differ as to whether it is desirable or not to have a soft-focus lens give a much-diffused image at the largest aperture—whether it is to be well-corrected or not. The tendency is toward the production of lenses with a minimum degree of diffusion at a large opening, and at least two such lenses (the Smith Synthetic and the new Verito) have made their first appearance during the year just past. For portraits this is an excellent arrangement, but the various planes of differing diffusion are very abrupt and the transition from one to the other is extremely sudden. With the older types, which had to be stopped down to F:8 or F:11 to secure workable diffusion, the quality of the image was much more under the worker's control. The large aperture lenses must be more carefully focused to secure the same quality of definition. This, of course, applies in the case of all lenses used at their largest aperture, *e. g.* the anastigmat.

Imperfect Correction. It is generally understood that soft-focus lenses give diffused images because of the imperfect correction of certain aberrations or optical

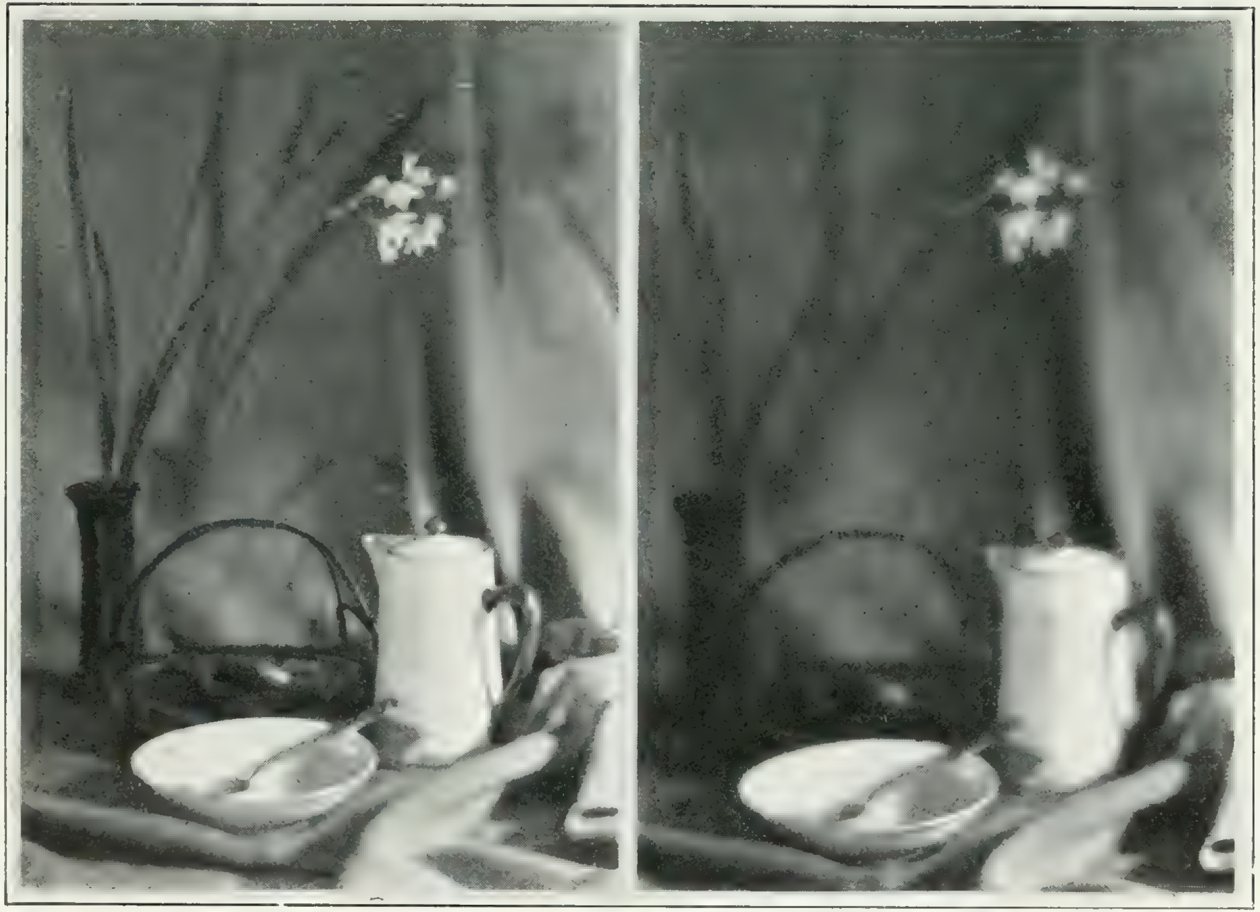


Fig. 2

Plane B in Fig. 3 See page 158 Plane C in Fig. 3

defects inherent to all lenses. In the modern anastigmat these defects are supposed to be wholly corrected or eliminated; in rectilinear lenses to a lesser degree. At the risk of wearying the reader already informed in this matter, I will briefly describe the two aberrations chiefly concerned in soft-focus lens construction, their influence in the definition of the picture-image, and their correction.

Spherical Aberration, the more important of these too optical defects, is illustrated in Fig. 3. It is the inability of a lens to bring to a precise point in the same

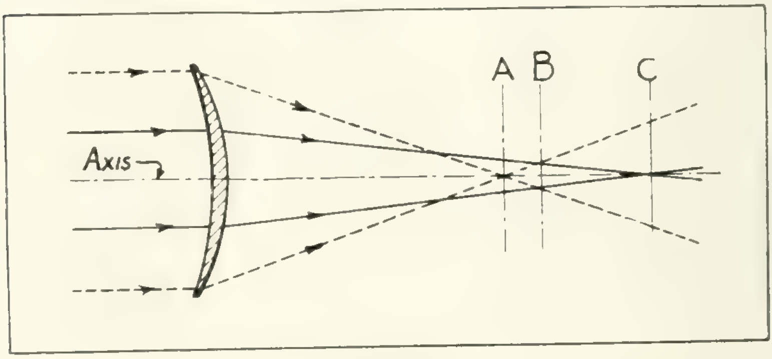


Fig. 3

focal plane both the central and marginal rays of the same pencil of light or bundle of light rays. It results in indistinct, diffused image points, or a scattering of the marginal rays, investing the light parts of the image with a perceptible blur of light or halo, the size of which varies with the degree of correction for the aberration. It is eliminated or controlled either in the construction of the lens or, in practice, by "stopping down," in other words by decreasing the aperture or diaphragm opening, thereby cutting off the marginal rays causing the confusion. From this it would seem to be an easy matter to produce soft-focus images by simply using a lens in which the spherical aberration is left uncorrected. As a matter of fact, this was the case with some early soft-focus lenses, of which the Puligny lenses may be mentioned as examples. But the more desirable diffusion effects characteristic of images given by our

modern soft-focus lenses is gained by a combination of this spherical aberration with chromatic aberration (to be discussed later), as the diagram makes clear.

This shows the marginal rays coming to a focus at A, a plane in front of the main focal plane C. They then begin to spread out again, and when they reach C each ray or light pencil has become a circle of considerable diameter, without well-defined edges. If focusing a soft-focus lens consisted simply of determining plane C, there would be little or no difficulty in the operation. It would be necessary only to "stop" the lens down sufficiently, say to F:11, focus sharply, and then open or enlarge the diaphragm aperture.

Halo. But the plate in plane C will give us the defect which has been termed "halo," to distinguish it from "halation" which it somewhat resembles. In this plane the image is sharp, but rendered indefinite and fuzzy by the spread of light from the margins. Thus, the lights spread over the shadows and the result is a flattening of the picture-image. The texture is also destroyed and the objects photographed appear as though seen through a veil or mist. The opposite of this is intended when a manufacturer says of his soft-focus lens: "It gives correct drawing without distortion, firmness of form delineation and softness of definition without loss of natural structure, the suppression of critical sharpness giving broadness of effect." Possibly the reproductions do not show this as clearly as the originals (B and C in Fig. 2), but every photographer who has used a soft-focus lens will know what is meant. The old-time "halation" was fought tooth and nail by photographers until rendered harmless by the introduction of films, double-coated plates, and the new developer, Neol. The question arises: if the manifestation or effect was wrong as "halation," condemned and fought, is it right in its resurrected form as "halo" in soft-focus photography?

Stopping down the lens as we have seen, will get rid of the "halo," but this will at the same time destroy the soft-focus quality. We have, then, a focal plane for the marginal rays and one for the central rays. A little thought will indicate that if the two sets of rays have a

common focal plane, there the definition should be firmest. Here practice bears out theory. The rays cross at the plane B in the diagram (Fig. 3), in which plane also the circle of confusion is at its smallest and the true soft-focus quality of image definition is secured. It is not a difficult matter to determine when plane B is reached, in focusing. The camera is first racked out or extended until the principal object appears sharp to the eye, disregarding the halo which forms. The focusing-screen now occupies plane C. Now the lens and focusing-screen are gradually brought nearer each other until the halo first observed just disappears, the focusing-screen being thus brought into plane B. Or, as an alternative method, the camera can be extended slowly, the image on the focusing-screen being observed during this operation. At first, interlinked circles appear all over the field. These gradually disappear as the distance from lens to ground glass increases, and finally disappear altogether. If the halo begins to appear at the same time, it is an indication that plane B has been reached and the focus established. It will assist in the determination of the correct focal plane if the photographer forms the habit of giving a reciprocating, back and forth movement to the lens or camera back by means of the focusing pinion, gradually lessening the amplitude of the oscillations until the correct focus is attained.

It is, however, the combination of spherical aberration with chromatic aberration which gives the characteristic quality of diffusion peculiar to images produced by soft-focus lenses. Since the spherical aberration may be controlled as already indicated, we will now turn our attention to chromatic aberration and the part it plays in the production of diffusion effects with soft-focus lenses.

Chromatic Aberration is the inability of the lens to converge a ray of white light reflected from a luminous point to a corresponding point of white light in the image, due to the dispersion or separation by the lens of the several color-rays which we know to make up the white-light ray. This dispersion of the color-rays, seen in Fig. 4, causes them,, when converged, to meet at

different distances from the lens instead of in a precise point in one and the same focal plane. As a result of this aberration or error, a lens which is not corrected

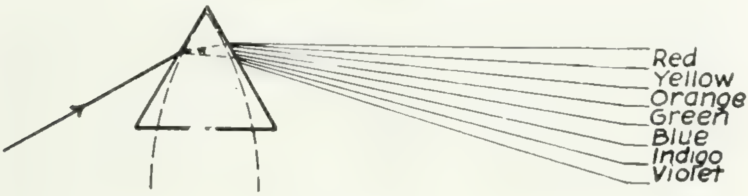


Fig. 4

for chromatic aberration, will fail to bring the visual (yellow and green) rays, by which we focus the image on the focusing-screen, to the same point of focus as the chemically active (blue and violet) rays which most

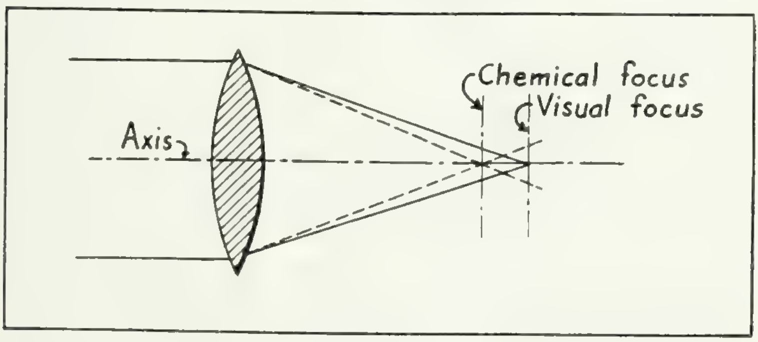


Fig. 5

affect the sensitive film. This separation of the chemical focus and the visual focus of an uncorrected (non-achromatic) lens is seen in Fig. 5.

Chemical Focus. According to the textbooks the separation between the two foci (chemical and visual) is from one-fortieth to one-sixtieth of the focal length of the lens, the blue lying nearer the lens by that amount. As a result the blue rays, after being converged to a virtual point, spread out again and form an aura about the focus of the yellow rays. With ordinary or non-orthochromatic plates, the blue rays being so much more actinic (photographically active) than the yellow rays, this produces an image similar to that resulting

from spherical aberration, though the halo, being smaller, will be relatively denser. With color corrected plates the impression of the yellow rays would be stronger and, if a fully correcting filter were used in focusing and in exposure, the effect in the negative would be as if the visual and chemical foci were identical.

Control. A series of experiments was made (using the camera as a lens-testing bench) with a 12-inch Struss lens, focused on a window curtain of rather coarse fabric. The lens was stopped down to F:11 to avoid spherical aberration, and three exposures were made on Standard Orthonon plates. The first was focused as sharply as possible with a magnifier; the second was made with the same camera extension, but with a K2 filter before the lens and proportionately lengthened exposure; the third was made after racking the lens in $\frac{1}{40}$ of an inch, as recommended. The plate exposed through the filter gave the sharpest negative of the three in definition, and would pass as one made with a rectilinear lens, the threads of the curtain fabric being clearly and sharply defined. In the other two exposures, while the one made at the visual focus has the greater amount of apparent halo, the curtain texture is approximately the same.

For practical pictorial use, therefore, the conclusion is that chromatic aberration, while it affects the result, can be controlled only in one way by the photographer, namely, photographing by monochromatic light (as in using an orthochromatic plate with a K2 filter, virtually light of one wave length), the softness resulting from this aberration affecting all parts of the image equally. As the halo is greatest at the visual focus, which is our plane C in Fig. 3 above, it follows that, in using such a lens, as we rack screen and lens together to secure better definition by controlling spherical aberration, we also improve the diffusion effect and minimize the halo resulting from chromatic aberration. Or we may do our focusing by the image we can see on the focusing-screen, and let chromatic aberration play its part unnoticed and uncontrolled. It is interesting to note, in passing, that the experiment described above in which an orthochromatic plate and K2

filter were used, is in agreement with the practice of Paul Lewis Anderson who, however, uses the Smith "Visual Quality" lens—a symmetrical doublet.

Achromatic Lenses. In the production of lenses of standard type, chromatic aberration is corrected by combining positive and negative lenses of different dispersive powers. Thus, by using two kinds of glass which differ in this particular it is possible to so correct this error that the yellow (visual) rays and the blue-violet (chemical) rays will be brought to one and the same focal point. A lens thus corrected for two colors is said to be achromatic: the visual and chemical foci are co-incident, so that the image obtained in the negative after focusing in the usual way will be identical with that observed on the focusing-screen. Lenses not so corrected are called anachromatic or non-achromatic. A lens in which more than two kinds of glass are combined, being thus corrected for three or more colors, is described as apochromatic and is used in color reproduction work. A lens corrected for both spherical and chromatic aberration is said to be aplanatic.

A Soft-Focus Lens, considered here as a type, is one in which the spherical and chromatic errors are either left uncorrected or only partially corrected, in greater or lesser degree, individually or in combination, the precise character of the diffusion effect given by any one lens or make depending upon the maker's or user's handling, balancing or proportional combination of the two errors.

Evolution. With the earliest soft-focus lenses diffusion and softness resulted from spherical and chromatic aberrations combined, due to the uncorrected single lenses composing the objective. Equality of definition was secured by the unusual "depth" of the lens, consequent upon its relatively small apertures and great focal length. The quality of the diffusion varied with the skill with which the visual and chemical images were blended in focusing, its degree being regulated by the aperture used. If this was decreased the definition was sharpened. Naturally, with such a lens there was always much uncertainty as to the quality of the result.

Later it was thought advantageous to diminish the amount of chromatic blur by correcting the chromatic aberration of the lens by one-half, this resulting in semi-achromatic soft-focus lenses. These gave a soft image with more firmness of drawing and an increased depth of planes. There followed a reversion to the diffusion resulting from chromatic aberration in excess of spherical error, with diminished flare or "halo." In its most recent form, however, the chromatic error is more or less completely corrected, the diffusion resulting from a careful balancing of the small amount of chromatic error remaining uncorrected and spherical aberration combined. The results secured with these lenses are very different from those obtained with the earlier semi-achromatic and anachromatic forms. They are simpler in use and more certain in result, giving images characterized by general softness or diffusion throughout, with a less abrupt transition from one plane to another and a greater firmness of structure and drawing.

A Distinction. From this it is apparent that, in the selection of a soft-focus lens, the distinction between the effects produced by spherical and chromatic correction should be kept in mind. With the latter sharpness of delineation may result if the plate is within the depth of focus of the lens, but with the former nothing need be sharp. In other words, the image of a point formed by a lens possessing chromatic aberration will be a point surrounded by a blur, while a lens possessing spherical aberration alone will represent some points by blurred points, others by discs, and others by rings.

Points for Purchasers. The man who intends to purchase a pictorial lens instead of becoming bewildered by the claims of the individual makers, should analyze his problems, setting down the amount of bellows draw available, the size of the front board, rigidity of the camera front, size of plate to be covered, and kind of work to be done. All these factors have a bearing on the sort of lens to be purchased.

There are several types of construction among the soft-focus lenses available, the simplest consisting of a single meniscus glass. Such lenses, in addition to the

aberrations already mentioned, suffer, as do all single lenses from distortion. This evil-sounding lens-defect is due to the position of the diaphragm or stop. It makes the lens incapable of rendering a straight line in the original as a straight line in the print. This is most apparent at the edges of the plate, and can be made less noticeable by the use of a lens of longer focus than is usual (a lens double the long side of the plate eliminates it practically): or it can be neutralized by making an enlargement or copy with the same lens, with the diaphragm in the opposite position. The lines bow to or from the center according as the diaphragm is behind or before the lens. It is, however, mainly with architectural subjects that this defect is likely to be objectionable, and so in ordinary landscape, portrait, and still-life work it can be disregarded.

Several lenses are available in the form of doublets. The doublets have an advantage over the single lenses in freedom from distortion, larger aperture, and greater covering power. Some of these are symmetrical, both glasses being of the same focal length, others are unsymmetrical. The rear halves, or combinations, may be used alone with these lenses, increasing the focal length but lowering the stop value. Diffusion is secured just as with the complete lens. Doublets are used for architectural work, copying, portraits, and for normal angle work of all descriptions. They are much bulkier and heavier than single lenses of equivalent focal length, thus requiring a large lens board and a rigid camera front, especially in the larger sizes. If these requirements can be fulfilled, the doublet is the lens to buy: where lightness, compactness and first cost are the deciding factors, the single lens scores.

Choice. The individual must decide for himself, by analyzing the work he will do, just the amount of diffusion he can use. For large heads in portraiture, greater diffusion is desirable than can be utilized for full lengths, as an example: if the bulk of the work done requires little diffusion at a fair speed, the doublets are good lenses, besides offering the advantage of an additional lens in the rear combination. The single lenses give more brilliant images, and are a practical neces-

sity if night scenes are to be made which include bright lights in the field of view. On account of the smaller amount of glass through which light must pass to reach the plate, the single lenses are appreciably faster than the doublets at the same nominal aperture. In addition, with some makes additional glasses of different focal lengths may be obtained very reasonably, which interchange with the regular lens in the same barrel, affording all the advantages which a battery of lenses offers to the user. Thus the advantages are pretty evenly distributed among the two classes, and the disadvantages as well. It is a case of "take your pick." In the last analysis, the best of work in any branch of photography can be done with any of the lenses mentioned: it is not the kind of lens so much as it is the correct use of the lens by the photographer.

Exposure. As in ordinary photography, the question of exposure is important. As a rule, the chief beauties of a soft-focus picture lie in the shadows: the exposure should therefore be full, to assure the greatest amount of gradations therein. There should be no hesitation about under-exposing if the subject seems to demand it, however: in this way a very flat subject may gain the contrast required to make it a picture. Under-exposure is also valuable when simplification and massing of the shadows is desired. It concentrates the attention upon the highlights and heightens their importance. Probably 90 per cent of the so-called "mystery pictures" are underexposed.

If there is any tendency towards harsh contrasts in the subject, which presumably would lead to the production of an undesirable amount of halo, under-exposure should be shunned. Two or three times the normal exposure would do no harm under these conditions. As a rule, with soft-focus lenses, as the aim is to get a short scale of harmonious gradations, rather than a brilliant, full-scale effect, it is better to give exposures which are on the full side.

Exposure determiners, both of the meter and calculating variety, are of great assistance to the novice and to the advanced worker venturing on unfamiliar ground. Some experienced workers are never without

them. Most of the time, the exposure indicated by the meter will give the desired result, but it is good to be able to vary it according to your own experience. Knowledge of correct exposure, so far from being a mechanical matter, will be best when it comes from the consciousness of the photographer. It is well to rely on books and meters at first, but do not be tied down by them. The factors governing exposure are few and simple: plates and films have a good deal of latitude; and the photographer who by persistent practice and a retentive memory has acquired the knack of correct exposure is the possessor of an invaluable asset.

It is to be noted that correct exposure is not necessarily normal exposure. Under-exposure and over-exposure are each in their turn correct exposure, provided the photographer exposed deliberately to attain a pre-visioned result. The necessity for keeping the ultimate result in mind—during the entire series of manipulations designed to bring it about—is clearly dealt with in THE PHOTO-MINIATURE: No. 178, "Photography as a Craft," the perusal and assimilation of which is recommended to pictorial workers sincerely desirous of improving their work.

The Development of the Plate, if properly carried out, should bring out all the gradations impressed by the light-action, without any harshness or opaque high-lights. The plate may be thin, or it may be dense, but it should not be too contrasty. The softness given by the lens should be supplemented by the development, to give a harmonious, well-graded negative.

All developers are capable of doing this, and the use of any particular one is a matter of personal preference. Rodinal and others of the paramidophenol class are good, as is M.-Q., but these must be allowed for, as the images lose density slightly in fixing. My own inclination is to the Kodak pyro-elon developer, as advised by them for portrait film. It can be used for either tank or tray development, does not stain the fingers, gives a good, quick-printing, warm-black image, and is particularly suited to the "open-tank" system of development which I use.

The Print. Now that we have a negative, which

does not have to be contrasty to be brilliant, we must print from it in a way to retain all the gradations and also secure an additional value or quality from the printing medium employed. For the straight printing of soft-focus negatives, nothing excels platinum or palladium paper. These papers are capable of good prints from the weakest of negatives, and with negatives which suit them are incomparable. Palladium gives a fine warm black especially suited to portraits, and at the present writing is less expensive than platinum paper, while coated on practically the same stock. It is advisable, in developing palladium paper, that a considerable increase of potassium bichromate be added over the amount specified in the maker's instructions, and the exposure slightly prolonged: in this way snappier, cleaner prints are produced, and many like the color better.

The better grades of developing paper are also excellent, as are most bromide papers. These are much used nowadays, and with the restricted scale of most pictorial negatives are more than satisfactory.

A very fine soft developer for developing and bromide papers is made according to the following formula: Water, 25 ozs; elon, 25 gr.; sodium sulphite, 100 gr.; sodium carbonate, 140 gr.; potassium bromide, 40 gr. It may be necessary to add more bromide if used for bromide papers, but it should work cleanly if the paper is new. This gives less contrast in the print than any developer I know, and is unexcelled for delicate effects resembling platinum.

Tone Values. The soft-focus photograph centers the attention upon the beauty of tone in the picture, by subduing the elements of line and detail: all the operations leading to the mounted print, therefore, should be performed so as to bring out the tone quality. Proper exposure, development, and printing are the only way to accomplish this. Photographers who affect to despise the technical side of picture-making deceive themselves. Patient study and experiment must be given to the proper use of the tools required; after one has learned this, he may use them correctly or not—the point is that he should know what he is doing.

This applies particularly in the printing from negatives made with soft-focus lenses. The process must be so carried out that the gradations of the negatives and their renderings of tone values are reproduced as nearly as may be. Of what use to take the trouble to get these in the negative if they are not reproduced in the print? With negatives made on the lines already suggested, this should not be a difficult matter. But there must be intelligent choice in the printing paper and careful work in the making of the print. After all, it is by the print that the photographer is judged.

The Lens in Use. To give specific directions covering the use of the soft-focus lens in different branches of photography is not practicable. Every soft-focus lens is, so to speak, a law unto itself, and the proper handling of any particular lens for this or that purpose or branch of work must be learned by experience. The science of photography, or, as one might say, the technics of the process, can be taught; but on the art or pictorial side there is so much of "feeling" (that "indefinable something" as Gillies puts it!) that we can give only hints and suggestions. The soft-focus lens belongs to the art side.

Portraiture. Perhaps the most extended use of the soft-focus lens lies in photographic portraiture, wherein its advantages are most apparent. Amateurs have long since appreciated this, but professionals are today everywhere coming to see these advantages and are adopting one soft-focus lens or another. The transition from the old-style portrait, perhaps with the face retouched out of all semblance of likeness and relatively distant parts so much out of focus as to be unrecognizable in form and texture, to the newer soft-focus picture has been rapid, but not sudden. Public taste progresses slowly and is more subservient to fashion than to actual merit. Hence the public of today is accepting the soft-focus portrait with natural hesitation. If it is too subtle in its quality; they are apt to warn the photographer that they prefer "clear" pictures to the "hazy" kind, though few can actually define the difference between the two, except to declare the "hazy" picture too indefinite in detail. Perhaps the public is

not far wrong! There should be no loss of structure or real indefiniteness of form in the portrait. But only the misuse of the soft-focus lens produces this haze and confusion or improper delineation of form; intelligently handled the lens is capable of exquisitely definite results, emphasis and subordination being properly placed.

Focusing is a detail of supreme importance in soft-focus portraiture. Generally speaking, those lenses which give a pleasing diffusion at their largest apertures, rather than an extreme degree, should be used. In any event, the art of focusing the portrait with any soft-focus lens is not difficult when once you have mastered the peculiarities of the lens in use. It is much more difficult to get good lens quality in a large head, when using an anastigmat at F:6, than with a soft-focus lens of the same focal length and rapidity. Preferably, however, the soft-focus lens in portraiture should have greater focal length than the anastigmat or portrait lens so often used in the studio. In early soft-focus portraiture much stress was laid on this detail of focal length as giving roundness and better drawing.

It is rarely desirable to swing the camera back to secure even definition with soft-focus lenses of correct focal length, although this should be done where the necessity is apparent. Care should be taken not to throw the focus too far forward, which is certain to result in objectionable halo, often so noticeable as a luminous band about the white collar in portraits of men. It is therefore advisable to focus so that the image of the eyes falls into plane B (Fig. 2), when the true soft-focus quality of definition will be obtained.

A Hint as to "Stops." It is generally recommended to the beginner in soft-focus work that he "stop" the lens down to a small aperture in his first use of it, and gradually enlarge the aperture in use as he learns how this influences the result. The trouble here is that when a soft-focus lens is stopped down, the image on the ground glass is virtually the same as though a rectilinear lens were used, and the loss in rapidity is often fatal to successful exposures. The essential problem in soft-focus work is thus dodged. The better plan, to my mind, is to risk a dozen plates or so in experiment;

use the lens at its full opening and practice with the most difficult subjects, *i. e.* those offering great contrasts of light and shade. By this method the biggest difficulty is mastered in the beginning, and the photographer will quickly determine the amount of "stopping down" required to give the desired effect in different sorts of subjects and conditions. The most pleasing definition is always gained at the largest aperture consistent with firmness in the delineation of the image. This will, of course, vary with the character of the subject and the light conditions. Obviously, the subject should be placed in a comfortable and unstrained pose or arrangement, so that movement of the head is unlikely, and the exposure made as soon as possible after exposure, to lessen the chance of movement.

Lighting is a big subject in any discussion of portraiture, but I may say, without fear of contradiction, that the lighting methods commonly used in studios employing sharp-focus lenses are not always suitable for the best effects when soft-focus lenses are used. As matter of fact, radical changes may be necessary in many instances. Thus, it will often be apparent that the volume of top light generally employed must be cut down, and the principal light allowed to come from the side and well to the front of the subject. This means a well-diffused lighting, tending to flatness but not losing roundness or modeling. Harsh lighting, as that given by an unscreened window in home or unconventional studio work, should be avoided. Either screen the window or work further back in the room. A good position for the subject under such conditions is given in Fig. 6. The sitter is illuminated by reflected light

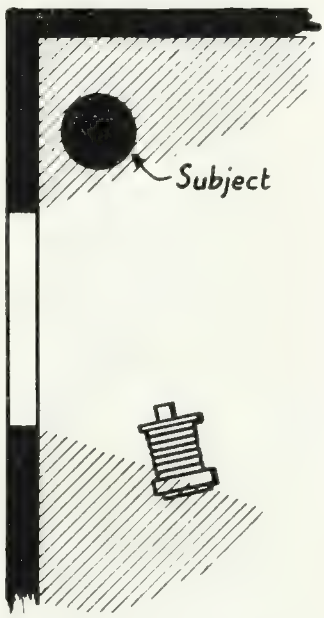


Fig. 6

only and a soft negative will result if sufficient exposure is given.

If trouble is experienced in working with side lighting, such as that given by a single window, it is possible that the light is not enough from the front, resulting in harsh contrasts and a lack of gradation. The two diagrams given in Fig. 7 show the trouble and the remedy. If the light first strikes the ear, cheek, and side of the head, as in A, the modeling will be lost. The

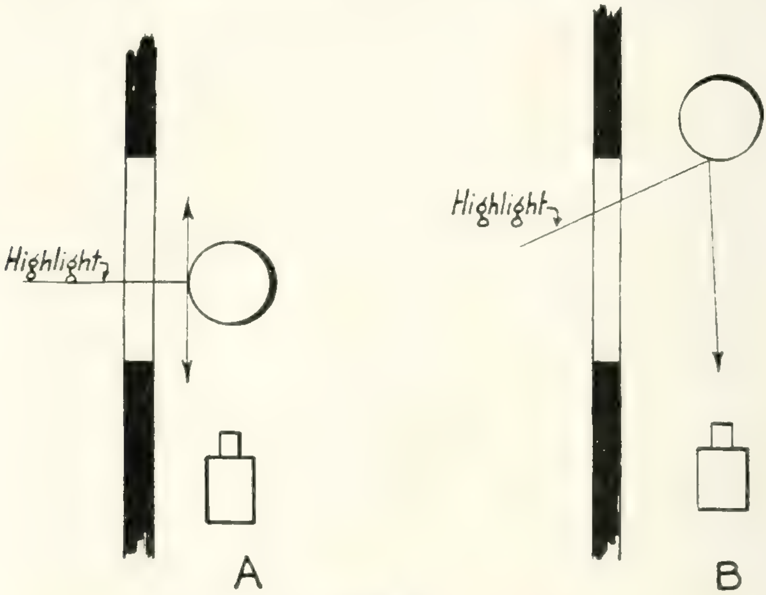


Fig. 7

sitter should be moved back as shown in B, when the light will fall on the features nearest the camera, the nose, temple, cheekbone, and chin, thus giving desirable modeling and roundness to the face and head.

The White Collar, which is an indispensable part of man's costume, has been regarded by soft-focus workers as one of their hardest problems. It is, however, an easy matter for the photographer to interpose between the collar and the source of light, some object such as a screen, folded newspaper, or sheet of cardboard. This will cut off some of the light falling on the collar, lowering its value or lessening its brilliance, and thus

eliminate the possibility of halo occurring, which latter, if the lens has been properly focused, is extremely unlikely anyway. The once-popular line-lighting is more difficult to do with a soft-focus lens than the sharp lens, because there is generally so little of the picture which shows lens quality: and there is always the possibility of the strongly illuminated nose shining with a haloed refulgence hard to explain in this day of the Eighteenth Amendment.

The introduction of the soft-focus lens has brought about a portrait-technic entirely different from the old one: a study of modern portrait photographs will show where the difference lies. The brilliant, snappy print, changing everywhere from light to dark, and utilizing to the full the capacity of the printing paper, has given place to the restricted scale picture, well related, and with proper values.

Artificial Light has been brought to such a high degree of perfection that practically every portrait photographer uses it to some extent. What with flood-lights, spotlights, and flashlights, the photographer has unlimited selection in his choice of illumination. It is well to remember, however, that eccentric lighting, while it will surely attract attention, does not make for the highest achievement in pictorial photography. We do not ordinarily see people surrounded by an aura of light which palpably is coming from the floor, although we sometimes see Mephistopheles so illuminated in his descent through the trap-door on his way to the Lower Regions. Many of the photographs made on this principle, as a matter of fact, look like the very devil. The subject does not have to be lighted in an eccentric, bizarre way to be attractive: the very facility with which fancy lightings are made should be a caution against their too-liberal employment. Concentrate upon the things that really matter in picture construction, and your pictures will stand the test of time, in addition to being pleasing from the start.

Landscape, with and without figures, is another branch of work which has benefited greatly through the increased use of the soft-focus lens. For landscapes the type of lens which must be stopped down to F:11 or

thereabouts is to be preferred to those which work well at full opening, especially those of 12 inches focal length or over. The depth of field of pleasing diffusion is apt to be too scant with the large aperture objectives, leading to halo in the distance. With landscape, focusing becomes difficult if performed for the foreground, as light-patches in the distance, such as the sky seen between tree branches, white church steeples, delicate cloud forms, and others which will occur to mind, are surrounded by halo which ruins the drawing and destroys the gradation. The remedy is to divide the focus, stopping down a trifle if necessary. A swing front is useful here, enabling one to get good definition in the foreground. Otherwise the distance, on account of its definition, competes with the principal object for attention, instead of taking the unassuming position ordinarily assigned to it.

On account of the many planes which must be correctly rendered, landscape is perhaps the most difficult branch of photography for the soft-focus worker. A good deal of the difficulty disappears, however, if the lens is of the type which works well at F:11 or so especially if of short focus. The large-aperture doublets if stopped down to this extent give what are practically sharp-lens images. This is not to say that excellent work cannot be accomplished with the doublets. If they are used as long-focus lenses and the subject chosen accordingly, pleasing results are readily secured.

Choice of Subject. As to this I think the open landscape is the easiest for a beginning. With growing experience, subjects with more definitely defined planes may be attempted, until the woodland interior is reached, where the excessive contrasts offer many difficulties too perplexing for the beginner. If figures can be introduced in these latter subjects, so much the better. But beware of the obtrusive figure in landscape work. There is a temptation to focus sunlit foliage so that the belt of halo around each leaf is twice the size of the leaf, it being believed that the vibratory quality is best secured in this way. This can easily be overdone. Halo is incorrect, whatever it is called.

Architecture. Opinion is divided, among experts, as to the use of the soft-focus lens in architectural work. But as the ideal in this recedes from detail and map-like exactness, so the soft-focus lens will assert itself as a useful means for representing the plastic and softened outline for which the master architect strives. Rectilinearity of line and a reasonably wide angle of field are prime necessities in this sort of work. It follows that soft-focus lenses of the doublet type will be preferred to the single lens. The aplanatism, short focal length and correction of the defect known as coma in this type of lenses makes them altogether suitable for architectural photography. Since firmness of drawing, texture, and the reasonable definition of detail are indispensable, that type of soft-focus doublet which gives evenness of diffusion over the whole field is indicated, together with the use of smaller apertures than are permissible in other branches of work.

Interiors should, if possible, be arranged so that the principal objects are brought into the same plane, this helping in securing evenness of definition. If a wider angle is desired than is obtainable with the lenses at present available, the "pinhole" provides an acceptable way out of the difficulty, especially in confined situations. I have seen a few remarkable photographs of circular stairways made in this way, which were altogether pleasing in definition of detail and perspective. Plenty of exposure must be given if the corners are to receive their share of illumination. The exposures may run into hours.

In Night Work, if the use of the doublet gives flare or or undesirable halo, space permitting, the rear lens of the objective can be used with advantage.

Still-life. The ideal field for soft-focus work is still-life, and this is the best field, also, for experimental work. If the foundation be correctly laid by experiment in an easy branch, the photographer can without difficulty work into the more advanced departments, as regards lens-focusing, of portraiture, landscape, and whatever else he would like to do. It is recommended that some photographs be made of objects which reflect the illuminant sharply, such as polished vases or

aluminum cooking utensils. This will supply valuable practice in focusing, and if the camera and subject are left undisturbed until the plate has been developed and inspected, it will prove an object lesson of more worth than much aimless experimenting.

A good many of the hints on portraiture apply with equal force to still-life. The illumination should be well diffused and the subject lighted without heavy shadows or too harsh highlights: arranged also if possible in one plane, so that a large stop can be used. Not only should the subject be arranged in a pleasing manner (if you do not know how to do this, see the books on composition) but its relation to the picture space should be made clear. There should be connecting lines or masses to tie the objects within the space—an important matter often overlooked and not excusable by the fact of the employment of a soft-focus lens.

In Enlarging. The soft-focus lens came into existence as a means of securing a certain quality of definition and rendering in the representation of natural objects. *Per se* it cannot and should not be expected to yield these qualities when used for copying a picture made with a sharp-focus lens. But it was early discovered that by the use of the soft-focus lens in copying, and especially in enlarging from sharp-focus negatives or positives, results of a pleasing character, as to definition, the softening of obtrusive detail and the like, could be secured. As a consequence the soft-focus lens is widely used in enlarging, especially by professional photographers.

In one method the enlargement is made direct from the sharp-focus negative with the soft-focus lens. The practice seems to be to focus with a small stop and when sharpness is secured the diaphragm is opened slightly, thus introducing spherical aberration and the consequent halo. But if halo, as ordinarily obtained, is bad, this particular variety is many times worse. In the finished enlargement it shows as a black fringe around the edges of the dark parts, most noticeable, of course, where they adjoin the highlights. Even those who tolerate ordinary halo, which is encroachment of

the light parts upon the shadows, do not like the effect given by direct enlargement with soft-focus lenses, which, after all, is the same as that given by direct work, although reversed. If the lens is so focused that there is no halo visible upon the ground glass, it would seem that a pleasing result could be readily obtained. Fig. 8 was made in this way, using a Verito lens at F:5. Negatives which are soft and not too contrasty are best for direct enlargement through soft-focus lenses.

Working with Positives. There are several methods of diffusing sharp negatives with soft-focus lenses much better than straight enlargement from the original, sharp negative because of the possibility of the black fringe occurring and so giving false rendering. These all consist of making a new negative by the use of the soft-focus lens, working from a positive made from the original sharp negative. This positive can be made on glass, film, or paper. If on glass or film, it should be made by contact with the negative in a pressure printing frame with strong springs. Either a slow ortho plate or Commercial ortho film should be used. The quality of the negative desired should be taken into consideration when making the positive. It would not be easy, although possible, to make a restricted scale negative from a contrasty positive and vice versa. The positive can be worked up and if necessary two or more can be bound up in register. This is a very easy way to add clouds to a blank sky.

If a thin negative has been made, which it is difficult to print from, a good dodge is to make two or three positives on film and bind them in register between glass. This increases the density of the shadows and preserves the transparency of the lights: no difficulty will be experienced in making a new negative from this positive combination as "snappy" as may be desired.

The positive, when finished, is put into the enlarger and projected to the size required, the exposure made on the sensitive material, which may be either thin bromide paper, glass plate, or film. Film is recommended, for with large negatives there is the danger of breakage. In addition, halo and halation are cut down

Fig. 8. Enlargement with a soft focus lens

AUGUST KRUG

to the minimum. The development methods already given can be used for both positive and negative.

Another Method is to make a print from the original negative, either by contact or enlargement, with an anastigmat lens. At this stage the alterations of values and combination printing are carried out: the new negative is then made in the camera by copying with a soft-focus lens and of course can be made of any size. This is the method used by nearly all the photographic illustrators who furnish a large proportion of the illustrations used by advertisers. A modification consists in making a solio proof of the original, printing in clouds if necessary. This is then copied with the soft-focus lens to the required size, the absence of grain of the print making it possible to enlarge quite a bit if necessary. In copying either a glass positive or a print it is possible to rack the camera so far out beyond the plane C of our diagram that the halo is spread over the entire picture and has no effect beyond a general softening of outline and flattening of the contrasts. This may or may not prove satisfactory in use, the difficulty being to secure a negative of sufficient contrast to print well. It is possible to use some soft-focus lenses in unorthodox ways such as this, and in skilled hands the result may be very pleasing. But until the manipulation of the lens is thoroughly mastered, the photographer who is wise will endeavor to use his lens in the way it was meant to be handled.

The Best Way. I refer, of course, to the most approved method of making the original negative with the soft-focus lens, thus gaining all the advantages it offers, and using an anastigmat or rectilinear in copying or enlarging. In this way only is it possible to secure an enlargement which retains all the pictorial qualities peculiar to the soft-focus photograph. The principle underlying this method, by the way, that is of obtaining the respective advantages of both anastigmat and soft-focus lens in the making of the photograph, has recently been utilized by Mr. Walter G. Wolfe, of the Pinkham & Smith Co., in the introduction of the "Wolfe Artistic" lens. In this he has provided a thin auxiliary lens of zero focus, which is slipped on the

front of a corrected lens (anastigmat, etc.) much as a ray filter is put on. This lens does not alter the speed or focal length of the anastigmat in any way, but it has the effect of diffusing the definition of the image and separating the planes, thus giving a more pictorial or more pleasing rendering of the subject than is obtained when the anastigmat is used alone.

Motion-Picture Work. A brief reference to the use of the soft-focus lens in motion-picture work may fitly end our discussion. Thus far, although employed in increasing degree, the soft-focus lens does not yet occupy an important place in motion-picture photography, and its use seems to be attended with questionable and ever-varying success. There can be no question of its ultimate appreciation in this field, but most motion-picture camera men seem to think that rendering the subject out-of-focus and true diffused focus rendering are one and the same thing. They are not. When camera men have learned how to use the soft-focus lens as it should be used, we may have very different results. At present there is too much disagreeable fuzziness and the haloed image is too apparent. In the making of close-up views and portraits better work is produced, though even here fuzziness and scatter are noticeable faults. It is possible that the existing soft-focus lens will have to be slightly modified for use in this field, by which it will be made to give the results desired with less uncertainty in unskilled hands. The new Visual Quality Motion Picture Lens seems, if I may judge by the work done with it by John Wallace Gillies, to be an advance in this direction.

August Krug.

Professional Opinions

Lack of space compels me to publish only the following extracts and notes, instead of the interesting letters from which they are taken.—EDITOR.

Pirie MacDonald: The old portrait combination type of lens set down separately and alone every item in the planes to which it was adjusted—as one pore, one area of flesh in which the pores are too minute to be distinguishable but crossed by infinitesimal wrinkles or folds, immediately next are a couple of blonde hairs and some more pores or dead hair follicles—and the projection of each item was in competition with each of the others.

In order to make a portrait that had the quality of showing the personality behind this catalogue of items it has been necessary to subdue the individual value of some or many of these items and make them combine and harmonize to the degree that they would be not so interesting as to intercept the interest of the subject as a whole—and that operation we call retouching, a necessary and perfectly defensible procedure. But, as the operation involved elimination of some items of truth, it was, of course, dangerous to the truth of the portrait as a whole and pointed to the possibility that whereas the lens recorded more than was necessary to demonstrate the subject and tended to the obscurement rather than the demonstration of the subject, the point of view of that type of lens was probably wrong as applied to the purpose.

The soft-focus lens, as a type, does not set down each item so separately as the old portrait type because it is so arranged that two of three extra projections are made over and beyond the one defined on the groundglass, and the light from one reflecting surface laps over and takes out the sharp definition of the adjoining dark, resulting in a continuous fluid texture, giving the light or dark tone of the locality as related to the tone of other localities in the subject and the portrait therefore relates rather than defines in its qualities. Unless the eye has been diseased and over-corrected in the application of glasses, people do not see faces as the old type por-

trait lens has recorded them. People with normal eyes see and remember faces in values rather than as catalogues of detail.

So, unless the soft-focus lens is misused to create bizarre and unhealthy effects, it has a proper and legitimate place in photographic portraiture.

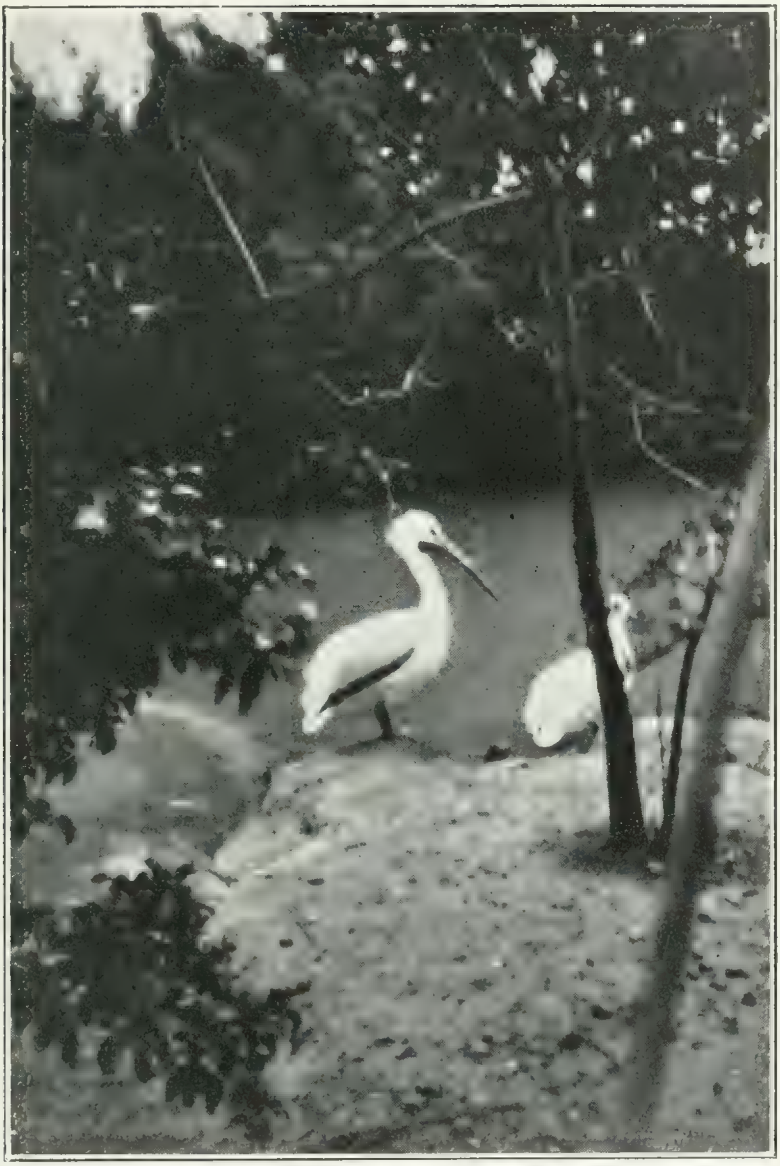
Francis Bruguiere: I think that the soft-focus lens is a necessary part of the photographer's equipment, as helping to diffuse the light at times in a kindly way. Especially for making large heads they have greater depth than the ordinary lens and give better drawing. But what is called artistic in photography is not the result of any lens but of what the photographer sees. I use the soft-focus lens chiefly in printing, that is, when I use it at all.

J. H. Garo: Personally, I do not advocate the use of soft-focus lenses in portraiture, for the reason that they are very apt to lose form and color relations. Of course, in the hands of an artist much can be done with this type of lens. For landscapes they are incomparable, lending themselves wonderfully to producing moods and atmosphere. Soft-focus lenses are a great aid in telling pictorial lies.

Too many photographers are using ths soft-focus lens imitatively rather than convincingly. After all, why not represent nature as the eye sees it. It is not the lens that makes things beautiful, it is the way one uses it, whatever its qualities. Good penmanship does not make good poetry. If one has nothing to say the lens will not tell it for him.

Lily Selby: Fundamentally, of course, an agreeable picture depends on composition . . . but it is of great assistance to the photographer to have softened lines, and the suggestion rather than the insistence of detail, which the diffused-focus lens gives, more especially when the subject is handled on a large scale. The blurring, however, is sometimes overdone, the mannerism of the technique being made to cover a multitude of sins; but this in no way detracts from the value of the soft-focus lens when properly used.

J. E. Mock. It is well to remember that the soft-focus lens is not adapted for every sort of studio



Original made with a Wolfe Artistic Slip-on Lens, on a plate $2\frac{1}{2} \times 3\frac{1}{2}$, and enlarged to 5×7.

A. CROWELL PEPPER

portraiture. Used with discrimination, I find it increasingly helpful. It gives a desirable roundness and recession of the planes; it keeps the subtle tones and light values which mean so much in a portrait and, by eliminating the need for so much retouching, helps to retain likeness. I am convinced, however, that most of the soft-focus lenses offered are too short in focal length to give the best results on the plate sizes for which they are listed. No lens of less than 18 inches focal length should be used for plates 5 x 7 to 8 x 10.

Charles H. Davis: The sharply detailed portrait is neither truthful nor desirable. We do not see people in that way. After ten years of playing with semi-achromatics and lenses of the soft-focus type, I am convinced that they fill a "long-felt want" in pictorial portraiture.

Dudley Hoyt: I cannot speak authoritatively as I still consider my work with the soft-focus lens to be experimental. But the most practical factor in its use is discrimination. Some things can be made with the lens; others must be left alone. The majority of the portraits now made with uncorrected lenses evidence an abuse of a really good thing.

Frank Scott Clark puts it very pointedly: Soft-focus lenses have thus far given us more indifferent photographs than good ones. This results, I believe, from the fact that the professional's knowledge of the lens is based upon his lifelong use of the compound lenses generally employed in the studio. The modern soft-focus lens demands quite other knowledge and an altogether different handling. It is important to realize that the light and shade values obtained by the use of the two types of lenses under identical conditions are different, and that successful soft-focus work cannot be done under the same conditions of light as usually give pleasing results where compound lenses are employed.

The key to success lies in the perfect rendering of the values in the portrait. Subject, background, and draperies, all must be in value, and this is dependent on the light conditions being so controlled that the soft-focus lens can yield its characteristic effects. It follows that the photographer seeking to make successful soft-

focus portraits must reconsider the problems of light and values from the painter's viewpoint.

Louise Bell-Rau, whose "Sweet Sixteen" is reproduced in this number, sends this note: The soft-focus lens interests me because it gives me not only softness, but also a seeming roundness, with depth and transparency in the shadows, thus adding something of beauty and mystery in the portrait. Whether your reproduction will show these qualities is quite another story. Also the soft-focus lens gives one power to express feeling and secure pictorial effect, rarely possible with a lens giving sharp and rigid definition throughout the field. The lens I use is the Smith Visual Quality, of 11 inches focal length, F:6.3.

Louis Fabian Bachrach: By the proper use of a soft-focus lens one obtains a degree of pictorial effect and atmospheric value in the photograph which cannot be secured with a lens corrected for sharp definition. Of course, it is easy to get overmuch diffusion, giving an unpleasantly blurred or woolly effect, which is as bad in that direction as the sharp-all-over negative is in the other. But the happy medium, with just the right degree of softness, cannot be improved upon from an artistic standpoint. This holds good particularly in large heads and outdoor portraiture.

Howard D. Beach: Discrimination is the word in the use of the soft-focus lens: in the choice of the subject for which it is to be used, in the choice of the focal length needed by the subject and the plate in use, in the handling and lighting, and especially in the focusing. This last I always do for myself, in order to make sure that the print will show the effect I desire. These soft-focus lenses are much like bucking bronchos and take unkindly to the bit . . . I am not an advocate of extreme softness of effect, except upon rare occasions. In my last year's work, more than half the work delivered was made with a soft-focus lens.

Katherine Jamieson. The soft-focus lens surely has a field in portraiture, but cannot be used indiscriminately for every subject or style. It is especially useful for large heads, faces of angular type, or where insistent detail is to be softened or subordinated . . . I am

fortunate in possessing an old Booth and Hayden objective, of pre-Civil War days. The original owner had placed a single coil of thin wire between the lenses of one of its elements. This gives me a pleasing degree of diffusion, roundness, and brilliancy. I desire no better soft-focus lens.

Helen E. Stage: During the last few years we have tried several different types of soft-focus lenses, but found some of them not "dependable" enough for everyday studio portraiture. By this I mean that, as one did not always get the same effect in the negative as was seen on the ground glass, there was too much guesswork and uncertainty of adjustment, with a consequent waste of plates. Of all we tried, we have found the Verito to be the best for our use. In practice however, we seldom use this in making the negative, preferring to first get a sharp negative with our Dallmeyer, and then make our prints, by projection, with the Verito.

E. Belle-Oudry: Undoubtedly, soft-focus lenses have their uses and advantages and, used with discrimination, are capable of producing very desirable effects in portraiture. I think, however, that until the public taste reaches a more general appreciation of the effects characteristic of soft-focus work, the professional photographer will wisely employ as much discrimination in its introduction as in the actual use of the lens itself. Comparatively few photographers have sufficient reputation to enable them to successfully impose a particular style upon their sitters.

I do not believe in the method of enlarging with a soft-focus lens from an original sharp negative. This results in flatness and lack of life. It is better to use a soft-focus lens in making the original negative.

Carle Semon: To my mind, the soft-focus lens is invaluable as an aid in the rendition of textures, particularly as applied to fabrics, draperies, and the like with which the photographer has so much concern . . . But it is a temperamental proposition! You must know your lens and what you want to do with it. Heaven help the man who is uncertain about either!

W. Shewell Ellis. Very few photographers of today

are making the sharply detailed portraits of a few years ago, but the usefulness of the extreme diffusion effects of some soft-focus lenses is really very limited in portraiture. The tendency among photographers is to overdo the diffusing, just as they have carried back lighting (by spotlight) to an absurd extreme. The best effects with soft-focus lenses are obtained only by a perfect balance of light and shade.

Eugene R. Hutchinson: My use of the soft-focus lens to the exclusion of any other has been based on adapting its individual characteristics to the psychological side of portraiture or any photographic interpretation of a pictorial nature.

Its rendering of textures, its interpretation of light vibration, I have failed to discover in any other lens.

It is quite possible, too, that having used this one lens over a period of thirteen years, I have gotten used to it! Much more might be said, but I am of the decided opinion that the lens is just a detail. You agree?

Notes from Pictorialists

Clarence H. White briefly sums up his experience:

Twenty-five years ago I bought my first camera, the most important factor in the selection being a $50 limit of cost for the outfit, a 6½ x 8½ view camera fitted with a Taylor-Hobson Rapid View Portrait (single achromatic) lens. Its focal length was 13 inches and it worked at F:11. What I required of the instrument was to make photographs to please my taste, and I was surprised when the photographs pleased others; but they did, and drew me into a circle of workers for whose judgment I have always had the highest regard. My photographs were less sharp then than many others. I do not think it was because of the lens so much as the conditions under which the photographs were made; never in the studio; always in the home or in the open, and when out-of-doors at a time of day very rarely selected for photography.

About that time new lenses were being made in an effort to get away from sharpness and hardness of defi-

nition, and one of these new lenses passed into my hands. I think it was the third made by Mr. Wolfe, of Pinkham & Smith, about seventeen or eighteen years ago, a Semi-Achromatic of 16-inch focal length, to use with 8 x 10 plates. I worked enthusiastically with this lens and the results stimulated the interest of others. I still use the Rapid View Portrait and the Semi-Achromatic and think they are indispensable. On my Graflex Camera I use a Ross Anastigmat, and I love to work with a pinhole.

Today the trouble with photographs, as I see it, is not all hardness and sharpness, as it appeared at my beginning; there is now a fuzziness and a muddiness that is bad. There is need of definiteness and depth, detail and tone. I have urged the manufacturers of the soft-focus lens with whom I come in contact to make a lens to work more definitely, and it is my observation that this is being done.

When advising students I recommend a rapid rectilinear lens for economy's sake, with which to get a start, and the careful study of the work of others, keeping in mind the use to be made of photography, and then the purchase of *the* lens or lenses.

I am often asked how I use a soft-focus lens. My answer is; "Through the study of the ground glass, the most inspiring step in making a photograph, and in letting my eye judge of the focus." I study the light as it falls on the subject, the distance from the source of light, the angle at which the light strikes it, remembering that a soft light is the most satisfactory for the soft-focus lens. In its use out-of-doors, with lenses of long focal length, I find the necessity of stopping it down and often adding a color filter. I dislike throwing anastigmat lenses out of focus or enlarging with a soft-focus lens to produce softness.

William Gordon Shields. . . In preference to the finest anastigmat (which I reserve for enlarging!), I carry a 9-inch soft-focus lens of well-known make on my quarter-plate reflex camera. This gives me better perspective and a pleasing separation of the planes. It is true that with an anastigmat of shorter focus and wider angle I might resort to trimming, but the angle

Made with a soft-focus lens of 9-inch focal length, F:6, and enlarged to 8 x 10 inches with an anastigmat.

Made with a short-focus anastigmat and enlarged with soft-focus lens. See page 192.

WILLIAM GORDON SHIELDS

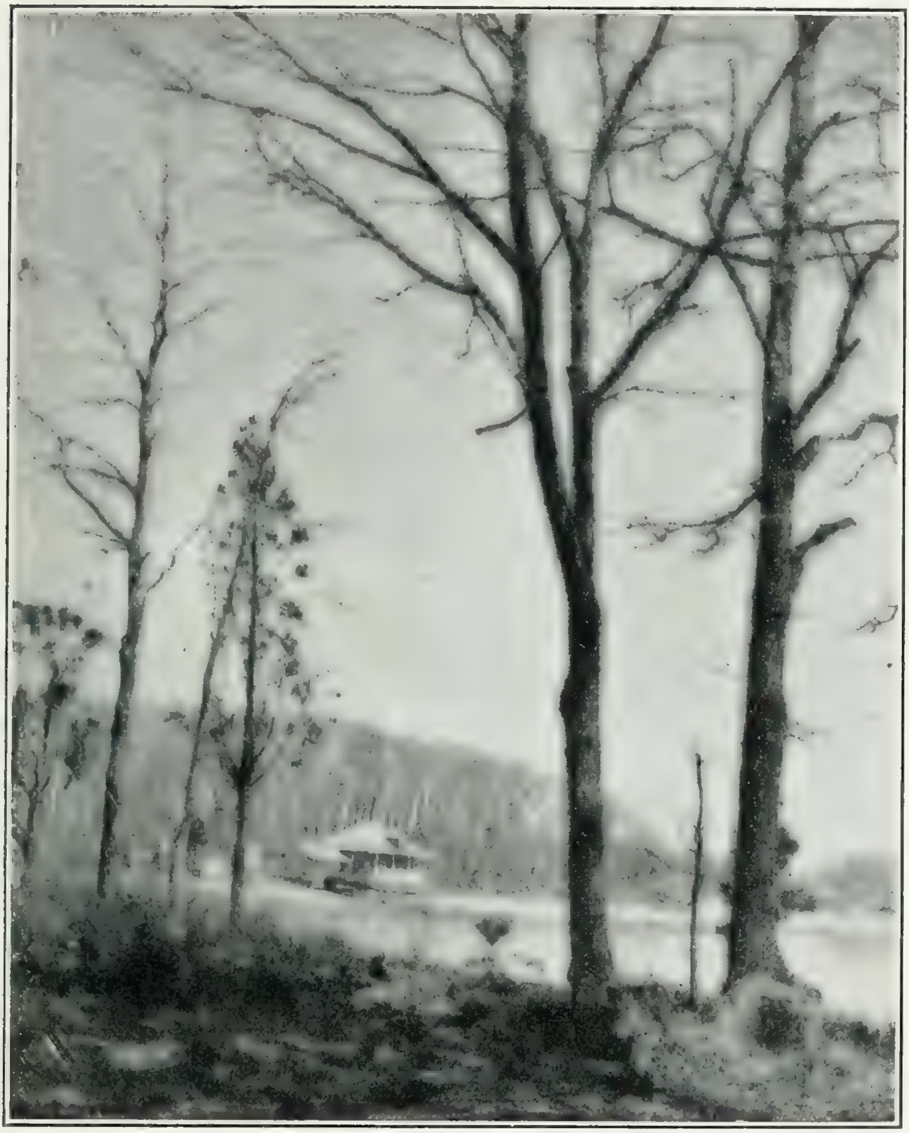
of view is really not changed by this, and very often the desired effect is lost. In the separation of the planes in the subject, the soft-focus lens enables me to accentuate the foreground if this is desirable, the background remaining in proper focal relation to the rest of the picture and yet retaining a pleasing quality. An anastigmat of the same focal length (and incidentally much higher price) would do the same in the foreground, but the background would be a succession of unsightly "blobs" of light and much out of focus, the planes being wholly lost to view. These qualities are illustrated in the two reproductions from enlargements submitted herewith, the legends under them giving the technical details.

All my negatives are made with a soft-focus lens on a small plate, 3¼ x 4¼ or smaller, and afterwards enlarged with an anastigmat. The idea of enlarging from a small sharp-cut negative with a soft-focus lens is a mistake, merely flattening the image and giving softness without the true soft-focus lens effect.

Henry Hoyt Moore: In the beginning I reveled in anastigmatic definition. Detail and crispness were my gods. But one day, admiring the pictures of Clifton Johnson, of "Highways and Byways" fame, I asked him, "How do you get those beautiful soft-effects in your photographs?" "I guess that is due to my cheap lens" was his reply. "What make is it?" was my question. "I don't think it has a name," he replied, "it's an old lens with those loose metal stops, and I lost the stops. That's why my pictures are soft." Then and there I realized that a cheap lens, without stops, or a lens designed to give diffused or soft effects, was necessary to my peace of mind. I got the latter, as simplest and best.

William H. Zerbe: There is a big difference between the diffused effects obtained by the various mechanical means or devices, and the true soft-focus effects obtained with a lens designed for this special work. Study examples of the two methods and you will recognize this difference . . .

It is a mistake, also, to try to get soft-focus effects by enlarging with a soft-focus lens from a negative



ON LONG ISLAND SOUND

An illustration of the effects secured by enlarging with a soft-focus lens from a small negative made with a sharp-focus lens.

E. L'H. McGINNIS

made with an anastigmat. You will get diffusion of a sort, but not the life or vibrating quality of the true soft-focus lens effect. A better way is to make a contact transparency from the sharp negative and from this make a new negative in the lantern, using the soft-focus lens for this.

Dr. E. L'H. McGinnis: . . . I use an assortment of cameras and lenses, running the gamut from a tiny Icarette with a Carl Zeiss lens, F:6.3, to a lordly Kodak No. 4 of extinct vintage, with a rectilinear at F:8. These give me clear, sharp negatives, and I can vary the amount of softness in the lines and masses when I enlarge (I am speaking only of landscape work), for which I use various makes of soft-focus lenses, single and double, of varying focal lengths.

In enlarging by this method I first focus the image as sharply as possible with the soft-focus lens wide open, and then rack the lens board a *little* backward or forward until I get just the degree of softness or diffusion desired. A good, healthy mouthful of pipe-smoke, blown gently or forcibly into the beam of light between lens and paper during the exposure, often gives a beautifully soft and atmospheric effect. If the gentle reader is a man, I suggest a trial of this dodge; if not, well . . . in these advanced times perhaps it may be safe to tell *her* to try it also.

I must not forget to add that in making my little negatives, I invariably over-expose and under-develop, which method seems to give me more satisfactory results for enlarging than the methods given in the books.

A Survey of Soft-Focus Lenses

The "Smith" Lens. Series I, F: 6 (Pinkham & Smith Co.), a single combination, semi-achromatic lens and **The Semi-Achromatic Doublet, Series II, F: 6,** were the original American soft-focus lenses, made twenty-odd years ago by Walter G. Wolfe, of this firm, at the suggestion of F. Holland Day, Francis Watts Lee, and other well-known pictorialists of that time. In loving and skillful hands the Semi-Achromatic lens gave results so pleasing and won such wide favor that, until within recent years, this was the soft-focus lens most generally used by pictorial photographers. In practice, however, the effects obtained with it were so variable and uncertain that it was decided to introduce a lens giving a firmer quality of definition, with a flatter field, and capable of bringing the chemical and visual images closer together, thus permitting of simpler and more certain use. This resulted in **The Visual Quality Lens, F:4.5,** made in doublet form, this permitting of its better correction and the use of larger apertures, without flare or halo and with a wide angle of field. As so made, this lens was adapted for hand-camera and motion-picture work. It was suggested by J. Wallace Gillies and is widely used by professionals in pictorial portraiture, giving diffusion effects between the extreme softness of the S. A. and the precise definition of the portrait lens.

The Visual Quality M. P. Lens is an adaptation of this lens to the special requirements of motion picture photography, by J. Wallace Gillies, introduced within the past two months.

The "Synthetic" Lens, F:5, a single combination suggested by J. W. Newton and named by Floyd Vail because of its quality for giving a synthesis rather than an analysis of the subject. In the Synthetic it is claimed that all the good qualities of the earlier Smith lenses are combined, with the advantages of a single lens as compared with the doublet or more complex construction; an actual working aperture of F:5; the most desirable diffusion effects variable at will, a flat field and even diffusion over the whole field. Altogether

a remarkable soft-focus lens! I am indebted to J. Wallace Gillies for the following hints as to its use.

"In the use of the Smith Synthetic Lens two points are of vital importance. First as to definition and focusing. Since at no point of focus may a sharp image be obtained with it, it is evident that a slight deviation from the point of critical focus will hardly be noticeable. Nevertheless, in the case of the Synthetic lens in particular and soft-focus lenses in general, there is a point in the belt of focus (corresponding to the field of depth of definition in other lenses), at which the most desirable degree of diffusion is obtained. In the case of the Synthetic lens, which because of its large aperture has a limited depth of definition, the focusing is more sensitive, and the most desirable diffusion effects are obtained when the lens is set at the point nearest the plate—witnin the belt of focus.

"All soft-focus lenses have hitherto been cursed with flare or 'run around' when used at the larger diaphragms The amount of run around depended upon the contrasts in the subject, and with the earlier lenses was in part corrected or modified by stopping the lens down, which had the disadvantage of giving sharper definition —perhaps undesirable. In the design and construction of the Synthetic lens, every effort has been made to correct this, so that the degree of diffusion as well as the amount of halo or run around shall, as far as possible, be under the control of the photographer.

"Coming now to the second important point in the use of soft-focus lenses, this concerns development of the plate. Many workers have been confused and discouraged by the general haze or veil which creeps over the plate during its development, quite unlike the clear, clean progress of the same plate when made with the ordinary corrected lens. Do not let this haze confuse you, but carry on development until good density is obtained. The plate will clear satisfactorily afterwards. A little more bromide in the developer will help a lot. I am presupposing, of course, the use of double coated plates and tray development. These plates are particularly adapted to soft-focus work because of the latitude they permit in exposure by reason of the fast ortho-

chromatic emulsion being coated over a slow contrast emulsion. Similarly, tray development is more suitable for this sort of work by reason of the larger control it offers the photographer as compared with the tank or automatic method."

The Wolfe Artistic is the latest addition to the long series of soft-focus lenses made by the Pinkham & Smith Co. To my mind this is by far the most interesting means for producing diffusion effects in photography yet introduced. In form it is quite unlike any other soft-focus lens, being simply an auxiliary lens of zero focus (no power) which, when slipped on in front of an anastigmat or rectilinear, straightway transforms the sharp focus lens into a soft-focus lens.

In this use of the Artistic there is no change in the qualities of the sharp-focus lens, except to give it the ability to produce a softly defined instead of a sharply defined image with, to be sure, the other desirable effects characteristic of the best soft-focus work. There is no appreciable change in the speed of the anastigmat and its full aplanatism is retained. Having no focus, the Artistic, when used with an anastigmat on a hand camera, produces no change in the focusing scale and calls for no change in the camera equipment. Another great advantage is the elimination of halation at full aperture.

The performance of the Artistic is explained by the fact that the addition of an auxiliary lens of no focus, made of selected glasses and of scientifically computed curves, to a highly corrected lens produces a volume of focus instead of a rigid focal plane. This volume of focus gives a breadth of planes and softness of definition (or degree of diffusion) approximating those given by the best of soft-focus lenses. I quote from a report on the performance of the lens by J. W. Newton: "With the Wolfe Artistic fitted to a Kodak Anastigmat, F: 6.3 on my 3A Special Kodak, I get a quality of diffusion, breadth of planes, a pleasing handling of the highlights, and an apparent stereoscopic relief in the near and middle distances of the subject which is plainly the result of a volume of focus rather than of diffraction. The degree of diffusion is controlled by the variation of the size of the diaphragm.

"I obtain, what is to me the most pleasing degree of diffusion by using my lens at full aperture and regulating the different planes by the scale of focus. (I am now referring to the use of the Wolfe Artistic on Kodaks and hand cameras that are focused by a fixed scale.) If I want soft, yet firm drawing in the immediate foreground, a soft middle distance with a gradual melting away of the distance, I set my focus at 15 feet. As you advance the focus to 25 feet, the middle distance becomes more firm with the distance less diffused.

"For landscapes I think the most pleasing degree of diffusion is obtained by setting the scale at 25 or 50 feet, or perhaps between those two points."

The New Verito, F: 4 (Wollensak Optical Co.), has greater rapidity, versatility, and control as its outstanding features, when compared with the earlier form, apart from its qualities as a soft-focus objective. This being said, it will readily be understood that the Verito is in high favor among professional workers, advertising illustrators, and motion-picture camera men, although largely used with the Graflex by amateurs in pictorial work.

In form it is an unsymmetrical doublet, rectilinear and therefore free from distortion, corrected for chromatic error and therefore giving the same image in the negative as that observed on the ground glass, without adjustment after focusing. It follows that the diffusion effects result from spherical aberration, and are controlled by varying the size of the aperture. Thus at its full aperture the Verito gives maximum diffusion; F:6 a moderate diffusion, and F:11 practical sharpness of definition. The quality of the diffusion can also be modified, with this lens, by reversing the positions of the front and rear combinations in the barrel or mount, this giving a greater firmness of definition and complete freedom from flare even under adverse conditions. When the front lens is screwed in immediately behind the rear element, a slightly softer image is obtained.

The Verito is convertible in the sense that the rear combination can be used alone, with a focal length

about 50 per cent greater than that of the doublet. This means two lenses in one, with different focal lengths. The diffusion given by the single element used separately is the same as that given by the doublet, the speed being slightly decreased, *i. e.* F:5 to F:6.

The qualities of the Verito are plainly apparent in its use for enlarging from sharp-focus original negatives. Here, by a skillful use of the diaphragm (the earlier Diffusing Stops being no longer used), a beautifully soft image is obtained, without halation or double lines, in any desired degree of diffusion.

The Kalosat, F:4.5 and F:6.3 (Hanovia Lens Laboratories), described as "The Spectral Diffusion Lens," is unique among photographic lenses in that it is constructed of quartz, having a high refractive index with a remarkable range of spectral transmission. This means that the Kalosat passes all the most valuable light rays of the spectrum, with the practical result that, at equal apertures, it has about five times the speed of fast lenses made of glass. It is obvious that this peculiarity puts an hitherto unknown power into the hands of the photographer. But we are here concerned with the Kalosat as a soft-focus lens, in which field it has an enviable record. In form it is a simple meniscus, so that there is practically no loss from reflection. When used at its full aperture it gives an image possessing spectral diffusion of delightful quality, combining a sufficiency of definition with breadth and softness and stereoscopic perspective. In the examples I have seen, of subjects against the light and exhibiting showing contrasts, there was no apparent halation or double lines and, when stopped down, the rendering of fine detail was all that one could desire without the slightest wiriness of definition. The difference between the chemical and visual foci (one-four-hundredth of the focal length of the lens) is so slight that it may be disregarded, a great convenience in focusing. The few portraits I have seen, made with the Kalosat, were noteworthy for the roundness combined with delicate color values which they exhibited.

The Plastigmat Portrait Lens, F: 5.6 (Bausch & Lomb). Among the reasons until recently advanced by pro-

fessional photographers, as justifying their reluctance to recognize the value of the soft-focus lens in portraiture, it was claimed that : First, when used at full aperture, these lenses gave negatives in which the highlights lacked detail, the shadows were clogged, and the diffusion too pronounced to be acceptable to the general public; second, that when stopped down to F:11 or F:16, in order to secure desirable detail and definition the exposure was unduly prolonged, with the risk of losing expression or of movement in the subject; and third, where adjustment of the focus was necessary, there was too much uncertainty as to the precise character of the result to be secured in the negative. In designing the Plastigmat Portrait Lens the makers have eliminated these defects and produced a lens for impressionistic work which has the rapidity necessary for studio portraiture, avoids the fuzziness and extreme diffusion disliked by the average sitter, gives detail in the deepest shadows without chalky highlights or the so-called double lines, and, last but not least, gives in the negative exactly the effects seen on the focusing-screen.

The Struss Pictorial Lens, F:5.5 (Frederick W. Keasbey), is a strong favorite with many pictorialists, with a record which amply supports the extraordinary claims made as to its qualities. In form it is a simple meniscus, fitted in a velvet-lined aluminum mount. This ensures a high light transmission efficiency with no loss by reflection, which means a brilliant image and illuminated shadows, with a greater actual intensity than other lenses of the same focal length and aperture but thicker and having more reflecting surfaces. Supplementary lenses are available, which, used interchangeably with the regular lens, offer a wide choice of combinations for different kinds of subjects and effects. The quality of the definition may also be varied by means of these combinations. As the lens is not corrected for chromatic error, it is necessary to adjust the focus before exposure, so that the quality and degree of diffusion is controlled by the user, and depends upon his skill in the use of the lens. To this, and the special character of the diffusion resulting from chromatic

aberration, the remarkable effects obtained with the Struss may be due in large measure. Thus, with this lens you can photograph directly into a blaze of sunlight on water or against the strongest light, and still retain the visual quality of the gradations without fog or flare. It gives a delicious quality in the rendering of textures and tone values, and firmness with freedom from mushiness in the lines.

Equal Diffusion Portrait Lens, F:4 (Gundlach-Manhattan Optical Co.). This latest among soft-focus lenses is announced as these pages close for press, so that I am dependent upon the makers for the following details of its construction and performance. As the name indicates, it is designed to meet the requirements of the portrait photographer; its largest aperture making it available for short exposures even under difficult light conditions. In form the lens is of the convertible type, consisting of two cemented combinations of unequal focal length. This gives the user a choice of three different focal lengths and makes the lens of great general utility. The chemical and visual foci of the combined lens and of each combination exactly coincide, which means that the image secured in the negative is identical with that obtained on the focusing-screen, without further adjustment of the focus before exposure. The whole lens is corrected for a flat field at F:4, and gives an image free from flare or double lines under normal lighting conditions. The optical effect obtained in use is a soft but agreeably well-defined image with the brilliancy resulting from good chromatic correction. I am informed that the lens has been thoroughly tested in practice by several professionals of reputation with complete success, thus satisfying its makers that it fulfils all their claims for it.

The Port-land Lens, F: 4.5 (Spencer Lens Co.), is not offered as a general utility lens, being designed for portraiture and landscape work. It is a single achromatic combination of unusual rapidity, with a flat field, corrected for rectilinearity, and gives a diffused or well-defined image at will. This diffusion being most largely the result of spherical aberration, it is controlled by the use of the diaphragm, so that by

stopping down the lens a sharp image is obtained. The degree or quality of the diffusion given at the largest aperture, however, is not excessive, giving soft lines and masses, luminous shadows and roundness of delineation without loss of form.

Ilex and Graf-Bishop. As these pages close for press I am shown two letters telling of the early introduction of new lenses of the soft-focus type by the Ilex Optical Company and the Graf Optical Co. Of the first no technical particulars are given, but the Graf-Bishop lens is described as a doublet composed of combinations of 14½ and 17½ inches respectively, with a flat field, corrected for color, and giving a pleasing degree of "diffusion with definition" at its largest aperture. The rear combination can be used separately and apparently gives a more diffused image, suitable for large heads and pictorial work.

The Dallmeyer-Bergheim Lens (Dallmeyer Ltd.) is composed of two single uncorrected lenses—the front a positive element and the back a negative element—the distance between which is variable. It is therefore of the telephoto type of variable focal length, providing a considerable range of different focal lengths and therefore of changes in the size of the image, by a simple twist of the tube or alteration of the camera extension, without moving the camera or sitter and with a comparatively short bellows extension capacity. It gives correct drawing without distortion and soft definition without loss of natural structure, the suppression of critical sharpness and unnecessary detail giving a desirable broadness of effect. The diffusion of focus which produces this softness of definition and delicacy of textural rendering results from the spherical and chromatic aberrations of the lens. The degree of diffusion is controlled by the aperture used and, if this be reduced to one-third its full size, a perfectly sharp image may be secured. The largest aperture is F:9. As the visual and chemical foci of the lens are not the same, it is necessary, in order to get in the negative the effect seen on the focusing screen, to first get the image as sharp as possible on the ground glass and then, by a turn of the focusing screw, to rack the camera in towards

the lens about 1-60th of whatever focal length is being employed. Thus, in portraiture, first focus the eyes on the point of sharpest definition on the screen, and then rack the lens in until the sharpest point of focus has been transferred to the ear, which will give the desired definition. Because of its great "depth" the lens gives equality of definition throughout the whole of the image and the planes are well differentiated. As recently improved, the Bergheim Lens has been considerably reduced in bulk and weight and is now available in three sizes, of which No. 1, for example, offers a range of focal lengths variable at will from 12 to 25 inches, measuring 4⅛ inches in length, 2½ inches in diameter, and weighing but a few ounces.

The Kershaw Soft-focus Lens (Marion & Co.), is a new British lens, with an effective aperture of F:5.6. It is a single achromatic lens, giving a firm quality of diffused definition, variable in degree by the use of smaller diaphragms. It is free from flare or halo even when used at its largest aperture, has a flat field, and, being corrected for color in part, the chemical and visual images are brought reasonably close together, so that the adjustment of focus required before exposure is very slight.

L'Eidoscope, the favorite soft-focus lens of French pictorialists, is made by Hermagis, of Paris (A. Madeline, New York). It has F:5 as its largest aperture, is listed in five sizes, and is said to offer special advantage in orthochromatic and color photography by reason of its perfect correction for color, which eliminates the displacement of the spectrum inevitable in the use of lenses not so corrected. This means that the visual and chemical foci coincide, so that the image obtained on the plate is identical with that observed on the focusing screen, without the usually necessary adjustment of the focus before exposure.

The Teleidoscope is a new lens of the same type recently introduced by Hermagis, giving images of from 1.9 to 3.5 magnifications with cameras having bellows extension of 5 to 14 inches. The front element of the Teleidoscope, used separately, has the speed of F:4, the speed of the complete lens being F:6 to F:14.

Plasticca, F:4 (Zwierina, Dresden), is a German soft-focus lens of noteworthy quality, largely favored by German, Scandinavian, and Italian photographers. I have no report as to its handling or performance, but examples of its work by the late Rudolf Dührkoop speak well of its ability to give characteristic modeling and diffusion.

Diffusion with Sharp-Focus Lenses, Discs, Screens and Other Devices

The desire for soft or diffused definition in the photograph goes back to the beginnings of photography. The pioneers in the newly discovered art-science, to be sure, were anxious to realize in the fullest measure all that the photographic process promised as a method of reproduction, and so sought to improve the rapidity and defining capacity of the lens. But, as the work of Julia Cameron, D. A. Hill and others of that early time tells us, those who wanted softness of definition obtained this, without fuss or trouble, with the imperfectly corrected lenses of their day, which were incapable of any great precision in this detail.

As photography developed, however, these early lenses were displaced by objectives in which rapidity and defining power were preëminent, until in the modern anastigmat these qualities reached their perfection. During this process of development, those workers who sought to secure in their photographs the natural rendering of things as seen by the eye, and in the works of the masters in painting and allied arts, were forced to have recourse to a variety of means by which this quality could be maintained in their work.

Diffusing Adjustments with Portrait Lenses. Thus, as early as 1866, the elder Dallmeyer introduced his "Patent" portrait lens, the first lens made with the deliberate intention of giving a softly defined image. This was so constructed that the two components of the back combination of the lens could be separated, which introduced a varying amount of spherical aberration and resulted in a soft, evenly diffused definition of the

image. This lens is still made by Dallmeyer and other opticians of repute, *e. g.* Taylor, Taylor & Hobson, Aldis, the Bausch & Lomb Optical Co., and others. Such objectives have the advantage of combining two lenses in one, capable of sharp or diffused definition at will. But it must be recognized that the diffusion effects so obtained and the general quality of the rendering of the subject are altogether different from those given by the modern soft-focus lens, which is deliberately designed to give what the French call the *flou artistique*, the nearest English equivalent for that subtle "flou" being fuzziness.

Single Elements of Portrait Lenses. A pleasing diffusion can also be obtained by the use of the front element of a portrait lens alone, in its normal position, while a greater diffusion is secured by screwing this element into the position usually occupied by the rear combination. This device affects the covering power of the lens, but does not materially change the axial definition, *i. e.* at the center of the field. A similar result is gained with the older focus of single landscape lenses by removing the fixed diaphragm or aperture fitted to such lenses and using the lens "wide open."

"Spectacle Lenses." Simple spectacle lenses, used in place of the ordinary photographic lens, will give pleasingly diffused images and are suitable for small work. For example: an uncorrected spectacle lens of 20 centimeters (about 8 ins. focal length, fitted into a spare lens-tube with a maximum aperture of 1½ ins. diameter (approximately F:5.5), will give a clearly visible, softly defined image on a plate 2½ x 3½ ins., retaining form and structural detail. An ortho plate should be used, the image focused to the visual focus and the camera back carefully racked in to the lens until the principal objects are slightly blurred, *i. e.* about ⅛ inch. Or a panchromatic plate with K2 filter may be used, exposed at the visual focus without further adjustment. This gives a well-defined image, not as soft as the first example just mentioned. The degree of diffusion here is controlled by the focusing or correct placing of the plate within the limits of the chemical and visual foci. The drawing and perspective

effects, size of image, etc., can be regulated by choice of the focal length of the lens.

The use of uncorrected lenses for soft-focus work reached its highest development in the anachromatic lenses of Puyo and Puligny produced in France 1905-6.

Combination. By adjusting a 26-inch focus periscopic plano-convex lens in front of a Tessar Ic (F:4.5), Latimer J. Wilson (*Photo Era*, March, 1919), states that he obtained small negatives exhibiting a pleasing diffusion of definition without the loss of other desirable qualities. The combination had a speed of F:4, being thus sufficiently rapid for artificial light portraiture. This device, in an improved form, is now available in the Wolfe Artistic Lens of 1921.

Diffusion by Diaphragm. The use of a diffraction grating in the diaphragm slot of the lens was proposed by T. R. Dallmeyer. In 1887, Lyman G. Bigelow offered American professionals a set of "diffuse-focus diaphragms" for use with portrait lenses, which diffused the sharp definition of the image at the focal plane of the lens while it sharpened up the receding or normally out-of-focus planes.

The Eastman Diffusion Disks of the present year offer a novel and effective means of obtaining soft definition in the portrait, without the necessity of investing in a special lens for this purpose. These Disks consist of a piece of optically flat glass, one surface of which is partially broken up by a series of ground and polished waves or bands running in circles. These are so placed that they soften the image before it reaches the lens, producing a combination of a sharp and a diffused image without pattern or objectionable fringes, the degree of diffusion being determined by the frequency of the waves or bands. In use the Disk is slipped on in front of the portrait lens usually employed in studios, the portrait is focused in the ordinary manner and no increase in the exposure is required. Disks giving two degrees of diffusion are available, each in two sizes. They are carried in a special form of holder adjustable to various sizes of studio lenses. In the hands of capable portraitists, such as Dudley Hoyt, the results produced by the use of these Disks are altogether

pleasing and satisfying. A variation of this form of Disk is employed for the diffusion of the picture image in enlarging with the well-known Eastman Projection Printer.

Scheibe's Diffusing Screen is a fine-grained glass screen, made for use with any sharp-focus lens, which produces a pleasing softness of definition which increases in degree as the planes of the picture recede. This softness or diffusion is free from flare, halo, or the double or confused lines so often resulting from soft-focus lenses, and in this respect in very similar to the definition given by the Dallmeyer-Bergheim, the separation of the planes varying with the focal length of the lens with which it is used. The screen lends itself in a peculiar way to the variation of effects by differential focusing. It is, of course, equally efficient as a diffusing device in making direct negatives or in enlarging from small, sharply defined negatives, and I am told that motion-picture operators are enthusiastic over the results it gives in that field of work. The examples of its performance in hand camera work (combined with a Wollensak Velostigmat, F:6.3), and in portrait work are convincing as to its usefulness and capacity for variation of effects.

The Use of Chiffon, etc. Of the many mechanical means of obtaining softness of definition or of suppressing excessive sharpness and detail in making negatives in the camera, in printing or enlarging, other than the methods already discussed, little need be said since the reader is doubtless familiar with them by long experience.

In Contact Printing, the definition and modeling of the original sharp-focus negative can be much modified and softened by interposing one or more sheets of transparent celluloid between the negative and the paper during printing. The degree of softening depends, of course, on the thickness of the celluloid or glass interposed. The best effects produced by this method which I have seen have resulted from a method devised by Charles Henry Davis. In this method, which calls for some means of exact registration of successive exposures, the printing paper is placed in contact with the

negative in a printing machine using electric light and a portion only of the total exposure required to give the print is made at this stage. The pressure pad is then released, the paper removed from the negative and a sheet of celluloid is placed over the negative. The paper, partially exposed as related, is now replaced on the celluloid screen so that the image is in exact register and a second exposure is given with the screen placed as described. The degree of diffusion obtained by this method differs according to the relative proportion of the two exposures. Thus, if the negative calls for a total exposure of one minute, the first portion, with negative and paper in close contact, may be 20 seconds, while the second exposure, with the screen interposed, will be 40 seconds. It is obvious that a variety of effects, both in the modelling of the subject and in the diffusion of definition, may be secured by the variations possible in the thickness of the screen and proportionate exposures given. The method has the great merit of almost completely eliminating any necessity of retouching the portrait negative, thus keeping all the original force of the lighting and delineation, enhancing the modeling of the features and, at the same time, giving any desired degree of softness or diffusion.

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Kallitype and Allied Processes

"Full many a flower," sang Thomas Gray, "is born to blush unseen, and waste its sweetness on the desert air." This is equally true of many a photographic process, as anyone may discover in an afternoon spent with the old books. But it is not true of Kallitype, which was seen at its first blush, thirty years ago, and has since flowered in innumerable varieties, to the keen delight of innumerable amateurs in photography here and abroad. The professional, too, has learned to appreciate Kallitype, although for him put in disguise and under another name, thus proving that Will Shakespeare was right in what he said about "a rose by any other name," etc. Which being said, let me add for the benefit of those who are ignorant and unashamed, that Kallitype is a very simple process for making beautiful prints. It is also a very inexpensive method, which is of moment in these otherwise expensive days. And, furthermore, it is as well adapted to the use of the veriest beginner as to the needs of the advanced professional, who seeks a new and better sort of print with which to persuade a higher price.

As a photographic printing process, Kallitype was first introduced by an English experimenter, W. W. J. Nicol, about 1889, in the form of a patented method which met with little commercial success. A few years later it was described in The Photo-Miniature:

No. 10, a curious little book about "The Blue Print and Its Variations," which set a goodly number of American amateurs to experimenting with the "Variations"—including Kallitype. This begat such popularity for the method, its virtues and their defects, that the photographic journals re-echoed with Kallitype for some years thereafter. Thus, in 1903, Henry Hall published a monograph on the method in No. 47 of this Series, of which over five thousand copies were sold during the year, and in due time we had a society of amateurs circulating a portfolio of Kallitype prints as evidence of their interest in the process.

Among the earliest Kallitype enthusiasts was Nelson C. Hawks, a Californian amateur, who introduced the paper commercially as Polychrome, and so perfected his product that prints on Polychrome paper could not be distinguished from the finest platinum prints—than which could be no higher praise. His formulas, given to "Camera Craft" in 1916, are republished elsewhere in these pages. Another enthusiastic worker in Kallitype is James M. Thomson, whose latest methods make up the bulk of this issue. Mr. Thomson began his experiments with Kallitype with the publication of the process in THE PHOTO-MINIATURE: No. 10, and has devoted much of his leisure during the intervening twenty years to its development. He writes as a practical worker, directly and to the point, and he is as eager to tell about the methods and formulas of other workers as about his own, so that his tale runs swiftly in the telling. But I think that he makes clear the interest and simplicity of Kallitype, so that the reader can be sure of successful results if he will "go by the book." The many Kallitype prints which he has sent me year after year, showing the adaptability of Kallitype for different classes of subjects, and the remarkable variation of colors and effects possible by using different paper bases and modifying the working formulas, completely justify the claim that no photographic printing process yields results more beautiful than Kallitype.

EDITOR

The steadily increasing interest in the Kallitype process, observable among professional as well as amateur photographers working along pictorial lines, is doubtless based upon the beautiful quality of the prints it gives, the wide range of color and surface effects it offers, and its extreme simplicity, both as to the preparation of the paper and its use. In these days of quantity production and commercialized methods there is an ever insistent call for the distinctive product, the thing that is different. And a Kallitype print made on the right sort of paper—which may be Japan tissue, Chinese pith paper, or any one of the wonderful papers made for the artist's or illustrator's use—is altogether different from a print from the same negative on the emulsion surfaced papers in general use today. In photography as a craft the individualist should make his print all the way through, from and on the sheet of paper which serves as the support of the picture-image.

The Theory on which the Kallitype process is based is in brief as follows. Paper coated with a mixture of ferric oxalate and silver nitrate gives, on exposure to light under a negative, an image in ferrous oxalate and silver oxide. Flooding this with a suitable solvent of ferrous oxalate precipitates an image in metallic silver. It is therefore classed as an iron-silver process.

The Iron Salts have been used as a photographic agent since the very dawn of photography. Thus Kallitype was preshadowed in the Chrysotype process of Herschel (1841), in which paper was coated with iron ammonia-citrate, the exposed portions having the power of instantly reducing gold or silver from their salts.

The Original Kallitype Process as announced by its inventor, Dr. Nicol, was somewhat complex, but later he simplified it somewhat. The revised formulas, as further modified by W. K. Burton, are here given for convenience of reference.

Sensitizing Solution. Distilled water, 1 ounce; ferric oxalate, 75 grains; silver nitrate, 30 grains. The ferric oxalate is first shaken up in warm (not hot) water, a few grains of oxalic acid being added to facilitate solution, after which it should be filtered, the silver

added, and then put away in a deep orange glass bottle, away from daylight, and allowed to "ripen."

Developer. For black tones: Borax, 2 ounces; Rochelle salts, 1½ ounces; water 20 ounces. For purple brown tones; Borax, ½ ounce; Rochelle salts, 2 ounces; water, 20 ounces. For sepia tones: Rochelle salts, 1 ounce; water, 20 ounces. For black tones: Soda acetate, 3 ounces; water, 20 ounces. From 8 to 18 drops of a one per cent solution of bichromate of potass should be used as a restrainer and to preserve the whites. Prints should be passed through a clearing bath of oxalate of potass (15%) before fixing.

Fixing Solution. Water, 20 ounces; hypo, 1 ounce; stronger ammonia water (.880), 120 minims. Nicol's original fixing bath was simply ammonia and water, there being no hypo in its composition.

American Improvements. There were certain faults in the earlier processes, which were remedied or overcome by American experimenters, in whose hands Kallitype methods were developed with considerable success. These early American improvements are typified in the formulas and methods of Henry Hall, published in THE PHOTO-MINIATURE: No. 47 (February 1903), and here given in greatly condensed form.

Hall's Formulas. Sensitizers: *A*: Ferric oxalate, 1 ounce; distilled water, 5 ounces; picked gum arabic, 48 grains. *B*: Ferric potassium oxalate, ½ ounce; distilled water, 8 ounces. *C*: Oxalic acid, ½ ounce; distilled water, 4 ounces; ammonia liq. (.880), 100 minims. *D*: Potass bichromate, 120 grains; distilled water, 4 ounces. For average negatives mix *A*, 1 ounce; *B*, ½ ounce; *C*, 30 minims; *D*, 4 drops. The sensitizer is made by adding 6 grains silver nitrate to 120 minims of the mixture. For thin and soft negatives increase the proportion of *D* from 30 to 50 per cent, and reduce the proportion of *C* by one half or more.

Developer. Sodium acetate solution (1 to 7½ of water), 8 ounces; tartaric acid, 12 grains; solution *D* (above), 10 to 100 minims.

Clearing Bath. If the acetate developer is used, clear the prints in a bath composed of: Sodium citrate, ¼ ounce; citric acid, 20 grains; water, 8 ounces. Wash

the prints well and fix for ten minutes in hypo, 1 ounce; water, 20 ounces; ammonia liq. (.880), 120 minims.

Many workers have had complete success with Mr. Hall's formulas, but in today's practice they have been largely superseded by the simpler methods and formulas published by Mr. Thomson. [*Editor.*]

Ferric Oxalate. The only difficulty likely to be encountered by the beginner in Kallitype will probably have its origin in the impurity or poor condition of the ferric oxalate used. A bad sample will result in yellowed or stained prints of a general poor quality. When a sample refuses to dissolve easily and completely, this can be remedied by the addition of oxalic acid, in the proportion of 2 or 3 per cent of the weight of the ferric oxalate used. A good sample should appear in glistening greenish-brown scales, this condition being discernible through the amber-colored bottle in which it is contained. When powdery, matted together, or inclined to cleave to the sides of the bottle, it should be rejected as worthless for our purpose. Once the bottle has been opened the salt is apt to deteriorate, unless special precautions are taken to prevent. Substitute a good cork for the shaved stopper, having first given it a soaking in hot paraffine-wax. In addition, keep the bottle in an air-tight preserving jar. Buy your ferric oxalate in ounce bottles. If kept in solution an ounce of ferric oxalate requires five ounces of water, to which may be added a few grains of oxalic acid. In this form it will retain its quality for six months if kept well stoppered and in the dark.

Simple Tests for Suitability. From Abney and Clark's "Platinotype" we learn that ferric oxalate solution, even when bought from the chemist, demands a certain amount of quantitative analysis. After being made in solution it should be tested in the following manner before attempting to use it for practical purpose: It should not turn blue with a solution of ferricyanide of potassium (red prussiate). It must not become turbid when boiled and diluted with ten times its volume of water. From the first reaction we ascertain the absence of ferrous salts; from the second that of basic ferric oxalate.

I have, in testing for suitability, found it sufficient to make a little pool of the ferric oxalate solution on a white porcelain plate, adding a few drops of a red prussiate solution. When suitable for practical use the reaction will be green, when unsuitable, blue.

The ammonia-citrate of iron keeps fairly well when tightly corked but in humid weather unless well corked is sure to absorb water and become a solid gummy mass.

Permanency. While Kallitype lacks the permanency of platinotype, it in this regard is at least the equal of any other similar process in which silver forms the image. In no other printing process is the resemblance to platinotype so marked. Prints made by some of the formulas herein submitted as far back as 1904 do not as yet show any signs of deterioration, though hung in a strong light. There is, moreover, no yellowing of the whites, indicative of perfect fixing and excellent quality of paper stock. With the alkaline-hypo bath now used there would seem to be no reason why a properly fixed and washed Kallitype print should not be as permanent as any other silver printing paper. Not one of the prints made by the Nicol formula and fixed as per directions in ammonia water but what have hopelessly faded. To guard against this it would be well to give a supplementary toning and fixing in a simple combined bath, which is compounded as follows: Sodium hyposulphite, 3 ounces; gold solution (1 grain to an ounce of water), 4 drams; water, 16 ounces. Dissolve the hypo in the water and then add the gold solution.

Suitable Paper. Any good linen paper will serve, a pure photographic stock paper not being essential. For prints as large as 8 x 10 the watermark so prominently present in many otherwise satisfactory brands of paper may be against their use. In the Crane bond papers the watermark very often proves the sole objection. The best quality ledger paper answers admirably for ordinary purposes, my personal preference being for Parson's "Scotch linen ledger," which comes in 17 x 22 inch sheets, and in at least two colors—white and buff. Wedding card bristol is good, as are also (where small

prints are involved) the finer grades of writing paper. Some of the most pleasing effects can be had on Old Berkshire cream laid paper. For soft results and "velvety" effects Strathmore Water Color Paper is to be commended. Nos. 945, light weight (smooth surface) and 946, heavy weight (medium rough surface), come in sheets of 22 x 31 inch dimensions. Nos. 947, heavy weight (smooth surface) and 948, (medium rough surface) come in 27 x 40 inch sheets. Where the Strathmore papers are unobtainable, recourse may be had to the Whatman papers, in which there is greater variety as to surface texture. The Whatman papers are much favored by British workers in this method. I have found them somewhat absorbent and they should be very heavily sized before sensitizing, in order to keep the image from having a sunken appearance. Japanese and Chinese pith papers are admirable for diffused effects, with a delightful sheen. Japanese tissue should be heavily coated with a gelatine-alum size. Where the tissue is mounted on heavier paper with dextrine in order to sensitize and print, the mount should be of linen fabric. Ordinary papers may contain chemicals that may be detrimental to results.

For ordinary purposes some papers are sufficiently sized when bought, but for fine work and velvety effects, it is well to apply a coating of arrowroot or gelatine size. The deposit of metallic silver particles which forms the image in this method requires to be plentiful and in an exceedingly minute state of subdivision, in order that we may have depth and richness. The image in a scantily-sized print wears down in process of time and the brush-marks are plainly discernible.

Sizing Mixtures. For a size we may employ arrowroot, using from 2 to 5 grains to the ounce of water. In a little *cold* water beat the arrowroot to a paste in an agate pan, adding the balance of the water *hot* and with constant stirring bring to a boil, when the mass will lose all cloudiness and become transparent. Strain through cheese cloth, and when there is a skin on the surface, remove this before use.

Gelatine size is prepared as follows: Water, 15 ounces; gelatine, 75 grains; powdered alum, 45 grains. The

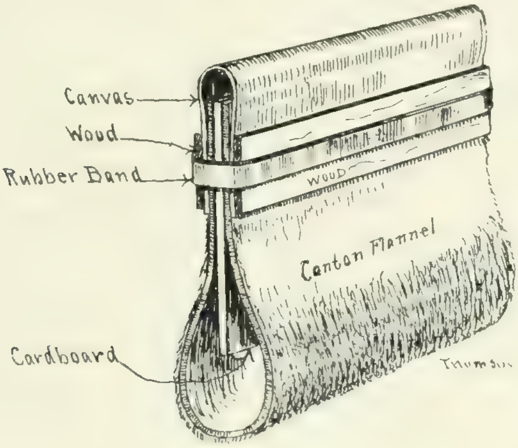
gelatine should first be swelled in cold water, then the balance of water added gradually with constant stirring and brought to a boil, when the alum may be added and the whole strained through cheese cloth as with arrowroot.

An "Ivory Finish" sizing solution, giving an excellent printing surface, is prepared as follows: Beat up the whites of 2 eggs to a fine froth, adding 3 drops glacial acetic acid. Let this subside, then strain through two folds of muslin, after which set aside for 24 hours. This is called an albumen solution. Now rub up 2 ounces of arrowroot in cold water to a thickish cream, smooth and free from lumps. Add water up to 25 ounces and with constant stirring bring to a boil for a few minutes in an agate vessel. When cooled remove the scum and beat up the mass with a wooden spoon. Add the albumen solution previously prepared and mix. Distilled water is advisable.

Sizing the Paper may be effected by immersing the sheets in the warm solution, or by coating with a brush or pad. Make a sort of Blanchard brush out of stiff white paper, bringing the two ends together. Over the bulbous end (it should be about 4 inches wide) draw a folded soft handkerchief, pinning or securing the loose ends with a clip. Coat the paper as evenly as possible, then with the flat side of a rubber sponge wrung out in warm water, go over the surface. Hang up by the corners in a warm room. Surplus moisture will thus gravitate to the opposite corner where it can be wiped away with the finger. After a second coating of the size suspend the sheets by a corner other than that previously employed.

Sensitizing may be done with a rubber-bound camel's-hair brush, or a flexible pad made from a piece of celluloid folded and covered with cotton or canton flannel. The accompanying illustration will give some idea of how the pad is made, the width being four inches. Pin the sheet to a board, pour a small pool of sensitizing solution in the center and immediately with full rapid strokes, go over every part, the endeavor being to wet the whole of the paper equally before any one part has dried. Avoid leaving pools of solution here and there,

which in the print will show up much too dark. When the sheet is surface dry complete its drying by artificial



heat. In order to avoid streaks in the finished product with smooth papers it is well to give a second coating. Short undecided strokes or uneven sensitizing will inevitably show in the finished print.

My First Formula. A modification of the Nicol Kallitype formula was reduced to a reliable working basis by me and published in the September, 1903, issue of the "Photo Beacon." Some time later a Western Kallitype enthusiast sent me half a dozen prints made by this formula, two of which are prized very much because of the richness of deposit and fine color. They are of a beautiful deep, rich brown such as is to be found in etchings. Colors all the way from sepia to dark brown have been obtained by the process. The essential operations are not at all involved.

The Sensitizer is as follows: Distilled water, 1 ounce; ferric oxalate, 75 grains; iron ammonium citrate (brown scales), 10 grains; chloride of copper, 9 grains; gum arabic, 10 grains. Dissolve the ferric oxalate in warm (not hot) water and let stand over night, then add the other ingredients and filter through absorbent cotton. The solution is not clear but rather of the nature of an emulsion.

Printing and Developing. Print until the deepest

shadows in the subject are well defined. The image will be of a salmon color. For a developer prepare: Rochelle salts, 25 grains to the ounce of water, and in a separate bottle 45 grains of borax to the ounce of water. By combining these two solutions in varying proportions for development different colors may be obtained in the prints. The more borax, the darker the tone. Add to the developer from 4 to 20 drops of a solution of bichromate of potass (10 grains bichrom. potass to 1 ounce of water). This acts as a restrainer and preserves the whites of the prints. Always use it to increase contrast. Leave the prints in the developer for half an hour, then rinse well and clear them in the following bath: Water, 16 ounces; stronger ammonia water, 1 dram; hypo, 240 grains. Complete by washing for half an hour and drying as usual.

A Later Method. In THE PHOTO-MINIATURE: Nos. 69 and 81 may be found a description and working directions for the "Thomson" method of working Kallitype, which differs from the original process of Nicol in the fact that the silver is in the developer rather than in the sensitizer. This method gives prints in pure black and white. The process in brief is as follows: A suitable paper is coated with the salts of iron and printed under a negative, this resulting in a faint image. A silver solution being at hand the exposed print is immersed, when instantly there flashes up an image of full vigor. Fixing for five minutes in weak hypo and washing for half an hour completes the essential operations. Once printing has been effected, development and fixing are completed in ten minutes.

The process as here outlined is most simple, but as in other early Kallitype methods there is sometimes present an element of uncertainty. As a rule all goes well, but the quality of the chemicals, especially the ferric oxalate, is all important. This iron salt even as it comes direct from the makers is inclined to vary and as often sold by the dealer is totally spoiled. As a matter of fact ferric oxalate should never be used without being tested. Before coating a batch of paper always test your ferric oxalate on a waste strip of paper by the method already given.

Formulas for working Kallitype after the "Thomson" method. Sensitizers: No. 1 (1903-4) Distilled water, 1 ounce; iron ammonium citrate (brown scales), 10 grains; ferric oxalate, 33 grains; oxalate of potass, 37 grains; chloride of copper, 6 grains; gum arabic, 10 grains; from 1 to 5 drops of a 10 grains to the ounce solution of bichromate of potass. This is particularly adapted for thin negatives but (as is the case also with other formulas), can be diluted when required, always adding distilled water. No. 2 (1903-4): Distilled water, 1 ounce; iron ammonium citrate, 6 grains; ferric oxalate, 30 grains; oxalate of potass, 30 grains; chloride of copper, 6 grains; gum arabic, 10 grains; bichromate solution to suit. For more contrast increase the amount of the bichromate solution; for less vigor dilute with distilled water a little at a time. No. 3 (1905): With this formula the results do not differ much from the foregoing, but in the present instance the provisional image exhibits increased visibility. Distilled water, 1 ounce; iron ammonium citrate, 25 grains; ferric oxalate, 15 grains; oxalate of potass, 35 grains; chloride of copper, 8 grains; oxalic acid, 15 grains; nitrate of silver, 15 grains; gum arabic, 10 grains, bichromate solution to suit. In preparing these solutions, mix the ingredients in the designated order (in a wide-mouthed dark-colored bottle) and then, without agitating more than is involved in turning the bottle upside down a few times, put away in a dark closet for 24 hours. Filter through absorbent cotton. Placing a wad of cotton in a glass funnel pour in the contents of the bottle, sediment and all. Take the wad between fingers and thumb and squeeze all liquid back, the gritty particles alone remaining in the cotton wad. This gets rid of the grit without sacrificing any more of the liquid than is necessary. The solution is now ready for use and should, when well stoppered, keep for months. The formulas are given in quantities of a liquid ounce to answer the needs of workers having small negatives. In making up for use simply multiply the proportions given in accordance with your requirements.

Sensitizing may be done with a flat, rubber-bound

camel's-hair brush, or with a flexible celluloid pad such as is herein illustrated. The pad may be covered with white canton flannel or white velvet.

Printing and Development. Do not fully print out; the half-tones should not be tinted. Presuming the subject to be a portrait, as example, the details of flesh, eyes, nose, mouth, etc., should not show at all, only the more prominent outlines being discernible. To bring the faint image to full vigor immerse the prints face down in the developer, immediately turning them over to break any bubbles which, if present, will result in white spots. There is no danger of over-development providing the exposure has been accurately timed.

The Developer. The stock solution for the developer should be made up as follows: Distilled water, 1 ounce; silver nitrate, 40 grains; citric acid (crystalized, when otherwise use half quantity), 10 grains; oxalic acid, 8 grains. Decant or filter through fine linen. An addition of 1½ grains phosphate of soda may be made where prints of a blue-black order are desired.

To develop, for each seven drams of water use one dram of the stock solution. This is for normal results and may be modified as required. The developing solution can be used over and over again until exhausted.

Fixing. Rinse the developed prints in water for a minute or two, then fix them for five minutes in hypo of the strength of 1½ to 2 grains to the ounce of water. If the whites of a print are at all dingy it indicates imperfect fixation. When such is the case allow longer time for fixing. Prints on rough paper may require as much as ten minutes. On no account, however, must a stronger bath be used as the reducing action would be detrimental to the finer tones.

Pictures quite equal to platinotypes in appearance are possible by this process. Beautiful rich gradation from quiet grays to the deepest of velvety black can be had providing the conditions are right and the chemicals all that they should be. The utmost cleanliness as to hands and dishes is essential to success.

Another Method. A Kallitype paper (Thomson)

giving brown, black, blue-green, blue and other prints by straight methods is as follows: Sensitizing is done in two stages, i. e. by first salting the paper with iron (*A*) and then silvering (*B*). Prepare the two solutions as follows: (*A*) Distilled water, 1 ounce; iron ammonium citrate (green scales), 35 grains; ferric oxalate, 8 grains; oxalic acid, 6 grains; oxalate of potass, 22 grains, uranium nitrate, 20 grains; gum arabic, 10 grains; from 3 to 6 drops of a 10 grains to the ounce solution of bichromate of potass. Let this stand in the dark to ripen for 24 hours, then filter through fine linen. (*B*) Distilled water, 1 ounce; silver nitrate, 50 grains; citric acid (crystals), 30 grains; tartaric acid, 10 grains. When dissolved decant or filter.

First coat the paper with the (*A*) solution and let it dry spontaneously; and then coat in like manner with solution (*B*). When this coating is surface dry, the drying may be completed with artificial heat.

Print in the sun to a visible image, the half-tones being but slightly tinted. The rougher the surface and the more porous the paper, the less printing time required.

Toning. For Sepia Tones: After printing, simply wash away the unaffected salts with plain water and fix the print for from 3 to 5 minutes in water, 6 ounces; common salt, 12 grains; hypo, 12 grains. Wash for half an hour.

For Green Tones coat on a buff paper. After printing take the print from the frame, rinse and immerse in water 4 ounces; ferricyanide of potass, 4 grains; nitric acid 4 drops. Remove the print from this solution just before the green tone is reached, dip it in a weak hypo fixing solution and wash for half an hour.

For Blue Tones. Coat on white paper, print, rinse and tone as above, but continue the toning action until the desired blue color is reached, then dip it in hypo solution and wash.

For Black Tones. Coat with the (*A*) solution given above, print for a faint image and develop with the Silver Solution given for the Kallitype Methods Nos. 1, 2 and 3, on page 219 but making the bath up to double the strength there given.

Uranium Toning. Slightly over-printed Kallitypes may often be saved or improved by toning with uranium, and should therefore be reserved for this after treatment. The process has a reducing action, and very beautiful effects are thus made possible, the tones of the normal black print being changed to brilliant purples, browns, and reds. The red chalk effects are especially suitable for vignetted heads in portraiture or vignetted figures of children. For such effects the paper is coated at the center of the sheet only, in the manner of studied carelessness familiar in vignettes, using a tuft of absorbent cotton wetted with the Kallitype sensitizer advised for black and white effects. Development is effected with a second tuft of cotton, after which the print is rinsed, fixed and washed, when it is ready for toning.

The Toning Bath is made up as follows: *A*. Uranium nitrate, 10 grains; glacial acetic acid, 1 dram; water, 5 ounces. *B*. Potassium ferricyanide, 10 grains; glacial acetic acid, 1 dram; water, 5 ounces. Mix *A* and *B* in equal quantities just before toning. Normally the print is immersed in this toning bath dry and the tray rocked until toning is complete. Swab the print back and front with a wad of absorbent cotton in running water. The toning action is stopped by placing the print in a tray of clear water to which a little acetic acid has been added. Washing is completed in 15 minutes. The tones obtained vary according to the proportions of *A* and *B* used in making the toning solution.

Blue Tones may be obtained, with black prints, by using the following bath: Water, 5 ounces, iron ammonia citrate, 5 grains; potassium ferricyanide, 5 grains; nitric acid, 5 drops. *Do not leave the print in the toning solution longer than is necessary.* Swab the print back and front and wash in running water until the whites are cleared.

Sepia Watertone Paper. This is a modified Kallitype paper which gives a printed-out image in the printing frame. In practice, however, the printing is stopped short of a fully printed-out image, as the after washing of the prints plays a part in further bringing out or

developing the picture, so that fully printing-out in the frame means an over-printed picture in the end.

This method is as simple to work as the familiar blue print process, but has never become popular, perhaps because the formulas recommended gave a paper which yielded prints lacking in desirable gradation quality. For example, I give the formulas first published by Brown in "The Amateur Photographer" of 1901, and later republished in his "Ferric and Heliographic Processes."

Brown's Formulas—for Line Prints. Four solutions are prepared, as follows: *A*. Green ammonia citrate of iron, 110 grains; water, 1 ounce. *B*. Tartaric acid, 18 grains; water, 1 ounce. *C*. Silver nitrate, 45 grains; water, 1 ounce. *D*. Gelatine, 30 grains; water, 1 ounce. Use distilled water throughout, but especially for *D* solution, which should be made at the time of use, by swelling the gelatine for half an hour in a portion of the water and then dissolving in the total bulk of water by placing the vessel containing the mixture in a pot of boiling water.

To prepare the sensitizing solution for use. Mix equal parts of *A*, *B*, *C*, *D*, as follows: Place the gelatine solution *D* in a shallow cup or tray, standing this in warm water. Add *A* and *B* and, lastly—a few drops at a time, stirred in with a glass rod—the silver solution *C*.

Coat the paper with this sensitizer while lukewarm, in a dimly lighted room or by gaslight. When the paper is surface dry, complete the drying with gentle heat. Print until a fairly vigorous image is obtained, with detail in the high-lights. Develop in plain water for about 2 minutes, and fix in a bath made up of hypo, 10 grains; water, 1 ounce. Fixing is complete in a minute or two, after which wash the print for half an hour.

This method, as related, does not give paper with good gradation capacity; but it is useful for architectural plan reproduction, line work, the preparation of rough prints in making drawings for process reproduction where the ink-lined image is bleached with mercuric bichloride, etc.

It is, however, easily possible to make a printing

paper of this sort capable of giving very desirable prints, fully equal to P. O. P. in gradation qualities. A dozen years ago I experimentally worked out a number of formulas for such a paper. Papers prepared with these and prints made with them quite ten years ago have stood the test of time satisfactorily, and a few of these formulas are therefore given here—suitable for average negatives and purposes.

Sepia Watertone. (Thomson) Salting Solutions. No. 1: Distilled water, 1¼ ounces; iron ammonium citrate, 40 grains; ferric oxalate, 10 grains; oxalic acid, 15 grains; oxalate of potass, 30 grains; gum arabic, 10 grains; bichromate of potass solution, 2 to 5 drops. No. 2: Distilled water, 1 ounce; iron and ammonium citrate, 32 grains; ferric oxalate, 16 grains; oxalic acid, 12 grains; oxalate of potass, 22 grains; chloride of copper 1 to 4 grains; gum arabic, 10 grains; bichromate of potass solution, 2 to 5 drops. No. 3: Distilled water, 1 ounce; iron and ammonium citrate, 28 grains; ferric oxalate, 6 grains; oxalate of potass, 30 grains; oxalic acid, 5 grains; uranium nitrate, 15 grains; bichloride of mercury, 4 grains; gum arabic, 10 grains; bichromate of potass solution, 2 to 5 drops.

The character of the image varies according to the particular salting solution used, but any of these may be used with confidence, choice being in some measure guided by the character of the paper employed.

Where ferric oxalate cannot be had the following salting solution may be substituted. No. 4: Water, 1 ounce; iron and ammonium citrate, 60 grains (green scales preferred, but if brown scales use 70 grains); oxalic acid, 8 grains; gum arabic, 10 grains; bichromate of potass solution, 1 to 5 drops. Paper salted with this will not give prints having the fine gradation of those made on paper salted with solutions Nos. 1, 2 and 3.

Mix the salting solution chosen in the order given and put away for 24 hours to ripen. Coat the paper in the usual way and dry, then in the same way apply the silver solution which is made up as follows: Distilled water, 1 ounce; silver nitrate, 50 grains; citric acid (crystals), 25 grains; tartaric acid, 10 grains.

Take the print from the frame before it is fully printed, wash away the unaffected chemicals which will develop the image, then fix for five minutes in a bath composed of: hypo, 6 grains; common salt, 6 grains; and water, 6 ounces. I use for measuring a mustard spoon that holds 6 grains of the hypo or salt, which with 6 ounces of water constitutes the fixing bath.

Varying the Tone. One can vary the color of the regular brown or sepia watertone print by slightly over-printing, washing as usual, and immersing in the following solution prepared beforehand: Hot water, 15 ounces; bromide of potassium, 60 grains; bichloride of mercury, 60 grains. This is ready for use when cold and can be used repeatedly. Bleach the print in this solution (the toned, fixed and washed sepia print) until the image entirely disappears. Wash for half an hour then develop in: water, 7 ounces; hypo, 1 ounce: leave in the hypo for 5 minutes, then wash for half an hour.

Mercurio Sepia Paper. (Thomson). The formulas for preparing this paper were originally published in The Photo-Miniature: No. 81, September 1907, but are possibly worthy of republication as the method is simple to work and inexpensive. It gives a paper yielding warm brown prints with wonderful transparency in the shadows. The picture image develops while printing and the print is completed by simply washing and fixing.

Paper Stock. A good, hard sized paper gives the best results, that usually advised and used in blue printing being very suitable. With soft porous papers there is difficulty in clearing the whites. Experimentally, high-class writing papers, heavy bonds, Marcus Ward's pure flax, Old Berkshire Mills, Bunker Hill linen, etc., gave excellent results. Such papers have a good body of size but are the better for an additional sizing with the arrowroot sizing mixture already given.

Inasmuch as rough papers absorb more liquid than smooth papers it is necessary to dilute the salting solution when sizing is heavy. In printing, overmuch

contrast simply operates to bury shadow detail. Prints should be washed soon after taking from the frame, otherwise even in the dark the printing action continues. In the deeper shadows there sometimes develops a disagreeable gloss which, viewed at a certain angle, detracts from the appearance of the picture. To remedy this, dilute Higgins' Photo Mounter to the consistency of cream and swab the entire surface of the print with it.

Salting Solution: Distilled water, 1 ounce; iron ammonium citrate (green scales), 16 grains; ferric oxalate, 20 grains; oxalic acid, 4 grains; bichloride of mercury (crystals), 4 grains; gum arabic, 10 grains; bichromate of potass solution to suit. Set aside in a dark place for 24 hours to ripen before using. As a rule this solution requires no filtering.

Less contrast in the print is obtained by diluting the salting solution. For brilliancy vary the amount of bichromate solution in the formula, from 1 to 10 drops per ounce of salting solution used. This bichromate solution, as already advised, is made up by dissolving 10 grains of bichromate of potass in 1 ounce of water. It is always best to add a drop or two of this in any salting solution, as helping to keep the picture image on the surface of the paper.

Silvering. After coating the paper with the salting solution, let it dry spontaneously, though when surface dry the drying may be completed by artificial heat. When so dry it is ready for coating with the following silver solution, after which it is allowed to dry and is ready for use. Silver Solution: Distilled water, 1 ounce; silver nitrate, 50 grains; citric acid (crystals), 35 grains; tartaric acid, 10 grains. Filter or decant the clear portion before use. The same pad or brush can be used for salting and silvering.

In Printing stop the action when the half-tones are just beginning to show, the high-lights remaining untinted. In other words underprint and allow water to do the rest. Wash away the unaffected salts, then fix for ten minutes in water, 6 ounces; hypo, 12 grains; common salt, 36 grains. A short time in the fixing bath gives yellowish brown tones, a longer time,

reddish-brown tones. After fixing wash the prints for half an hour in several changes of water.

A New Formula—1921. For some years past the public taste as to the color of photographs has inclined to various shades of brown, commonly known as sepia-toned prints, usually produced by the sulphiding process, although at the moment high-grade professional photographers favor a warm-black tone.

During the past summer I have experimented in an effort to work out a formula which would give me prints of a pleasing warm brown. After considerable work I have succeeded and can now get, by a direct method, prints in varying depth of rich brown tones, such as have heretofore been possible only by toning with uranium or copper. In this latest method of Kallitype printing, a simple modification of the developing agent gives tones all the way from tan to seal-fur brown, the deeper tones being especially rich and transparent. By another change sepia of a cold tone can be obtained.

Paper. A linen paper, well sized, seems to be the more desirable where permanent prints are required, but some of the most beautiful results were obtained on Strathmore detail drawing paper which I purchased at 25 cents per yard. This comes in white and buff tint, has an excellent surface and is fairly tough in substance. One can usually buy it from artists' or architects' supply dealers.

Sensitizing Solution. A normal sensitizer for this method is prepared as follows: Distilled water, 1 ounce; citrate of iron and ammonia, 40 grains; ferric oxalate, 16 grains; oxalate of potass, 18 grains; oxalic acid, 2 grains; iodide of potass, 2 grains; gum arabic 10 grains; platinum solution, 10 drops; bichromate of potass solution (2 grains to the ounce of water), 2 drops.

The platinum solution above mentioned is made up beforehand as follows: Distilled water, 2 ounces; chloroplatinite of potass, 15 gr; phosphoric acid, 2 drams. Dissolve the chloroplatinite in a portion of the water, add the phosphoric acid and then sufficient water to make the solution up to 2 ounces.

The paper is coated as advised in earlier pages, but

the sensitizing solution should not be used for at least 12 hours after mixing, as it has its maximum effects only after being allowed to ripen.

Printing. On a starch sized paper there is some difficulty in estimating exposure correctly, especially if there is not much of light tone in the subject. On a heavily sized (arrowroot) paper the image may show up of a blue tone upon a yellowish ground. Where there is difficulty in gauging exposure it is best to employ test strips as in gaslight printing. Printing is fairly rapid and is best done in sunlight.

The Developer is prepared as follows: Distilled water, 1 ounce; silver nitrate, 50 grains; citric acid, 20 grains; oxalic acid, 6 grains. When all the ingredients are thoroughly dissolved, filter the solution through linen or decant the clear portion.

Development. A porcelain tray is the best suited for Kallitype work. To develop for a normal tone, take 7 drams of water for each dram of the above stock developer. For lighter brown tones, double the amount of water. A very desirable tone effect can be had by still greater dilution. The greater the proportion of oxalic acid in the developing solution, so much darker will be the tone of print and the steeper the gradations. The image will come into view as soon as the developer covers the exposed print, but this should be allowed to remain in the solution for half a minute. When development is completed, wash the print for three minutes and fix for five minutes in a weak solution of hypo, say 1½ grains hypo to 1 ounce of water. If there is too much reducing action observable in this bath, it is well to use a more dilute solution. On the other hand, in cases of over-exposure one might use a stronger fixing bath with advantage, adding a small amount of common salt, and leaving the print in this bath upwards of half an hour. After fixation is complete, wash the print for half an hour drying as usual. Kallitype prints should be dried flat and mounted by a touch of paste at the two upper corners. On no account should hot iron or dry mounting with heat be employed, this destroying the tones, although this can in such cases be recovered by wetting the print.

A Precaution. As in other Kallitype methods, so here, success depends in a great measure upon the quality of the ferric oxalate. Deterioration of the other chemicals may also cause poor results. A newly mixed solution of silver used as a developer in this process was found to have very little darkening effect. This was apparently the result of silver nitrate crystals having deteriorated in an imperfectly corked bottle. But most silver solutions improve by ripening. The citric acid also may cause trouble. When in the developer it has a bleaching effect which is remedied by reducing the portion used. The crystalized form of this acid is the best and gives very little trouble.

Those who have in the past tinkered with Kallitype as usually exploited will find even the most involved of submitted formulas comparatively easy to work. The formula given in preceding pages for producing prints in black and white is much easier than any heretofore brought forward, and cheaper withal. There is no other Kallitype formula where so small an amount of iron and silver salt will do so much and give results of desirable quality. Thus eight grains of silver nitrate in solution will develop a dozen 5 x 7 prints and the developer may be used until exhausted. There should be the utmost cleanliness in every part of essential manipulation. Guard against touching prints with silver-stained fingers. Wash the hands from time to time and when handling prints take them between finger and thumb. As developing stains the fingers, rubber gloves or finger tips may be used. I prefer to use the bare finger tips, but it is a good plan before beginning to work to rub the fingers with paraffine wax. A useful pomade for this use can be made from melted butter and beeswax, equal quantities of each. When the fingers get very badly stained, bathe them in sodium sulphide then wash the hands in soap and water, when the dirt can be rubbed off with a rough cloth or brush. This, however, is a last resort and cannot safely be repeated often.

The Hawks' Formulas. ("Camera Craft" 1916). In his experiments, Mr. Hawks used a large variety of papers but he especially recommends the use of

Weston ledger paper, which comes in sheets 23 x 31 and has a weight of 70 pounds to the ream. Parson's Scotch ledger is also good. Most papers are better if sized with a solution of arrowroot, gelatine or starch, 7 or 8 grains to the ounce of water, prepared as usual.

Sensitizing. The paper after sizing and drying, is sensitized in the usual way, the following sensitizing solution being prepared beforehand: Water, 4 ounces; ferric oxalate, 400 grains; potassium oxalate, 100 grains; silver nitrate, 100 grains. The water used must be tested for purity. The amount of oxalate of potass and nitrate of silver may be reduced to 90 grains each without harm but always use like amounts. This sensitizer should be filtered through fine linen before used.

Printing is always the most difficult part of the Kallitype process. The right time at which to stop the exposure in printing can be known only from practice. Mr. Hawks advises exposure to direct sunlight, the printing being stopped as soon as the outlines of the shadows of the subject are visible.

The Developer is compounded as follows: Hot water, 18 ounces; powdered borax, 1 ounce; sodium tartrate, 1 1/4 ounce. Dissolve the borax first and when the solution is partially cooled, add the tartrate of soda. Rochelle salts may be substituted for the latter if desired. To use, take 4 ounces of this solution and add 1/2 dram of a 2 per cent solution of bichromate of potass. This developer gives a rich, velvety black tone, which may be made warmer through all the shades of brown, by simply reducing the quantity of borax used. If the purplish-brown tone be desired, add a few drops of phosphoric acid to the developer.

Development. It is better to use two trays in development, No. 1 containing the developing solution with the normal amount of restrainer, viz, 1/2 dram bichromate solution for each 4 ounces of developer. Tray No. 2 to have only 2 or 3 drops of the restrainer to 4 ounces of developer. Place the exposed print in tray No. 1 for three seconds only, watching closely to see if the half-tones come up properly. If they do,

leave the print in this tray, rocking gently till the image is fully developed. If the half-tones do not come up as they should, and the print shows too much contrast, transfer it quickly to tray No. 2 which will bring up the half-tones in detail. As soon as these are sufficiently developed, place the print back in tray No. 1 and leave it there for five minutes, to clear the whites.

Fixing. After the prints are fully developed, rinse them for two minutes and place in a bath made up of water, 1 quart; stronger ammonia, 2 drams. Fixing will be complete in ten minutes. After fixing, wash the prints in 5 or 6 changes of water and dry between blotters in the usual way.

Platinum Toning. To convert a print made by this method into a pure platinum print, develop as above described and then, after washing for a minute in clear water, immerse the print in the following toning bath: Water, 18 ounces; chloroplatinite of potass, 8 grains; common salt, 75 grains; citric acid, 75 grains. Rock the tray until the proper platinum tone is obtained, rinse well and fix the prints in: Water 1 quart; stronger ammonia, 3 drams, washing as usual. Over-exposed prints which show bronzing can be corrected in this toning bath.

Argento-Platino Paper. Early in 1914, owing to the difficulty of obtaining supplies of platinum, the makers of platinotype paper announced "a simple and inexpensive photographic printing paper prepared with platinum and silver." The new paper gave results possessing much of the quality and appearance of the makers' unrivaled platinotype paper, but of a warmer black color as to the image.

It so happened that in 1907 I had reduced to a workable basis a paper of a similar kind, which I assigned to the Kallitype Group. The formula was published in "The Photographic Times" in 1913, a few months prior to the announcement mentioned above, and a revision of the formula in "American Photography" in November 1915. There is this difference between the two papers. In the commercial paper, the sensitizer had as ingredients the salts of iron, platinum and silver, the faint image given by exposure being brought

to full vigor by development with potassium oxalate. In my method the potassium oxalate is in the sensitizer and development is effected with an acidified solution of silver nitrate.

The Sensitizer is as follows: Distilled water, 1 ounce; ferric oxalate, 20 grains; iron ammonium citrate (green scales), 20 grains; potassium oxalate, 18 grains; platinum solution (see below), 10 to 12 drops; bichromate solution (5%) as required, e.g. from 3 to 10 drops; gum arabic 10 grains. The platinum solution called for is prepared as follows: potass chloroplatinite, 15 grains; phosphoric acid (50%), 2 fl. drams; distilled water to make bulk to 2 ounces. First dissolve the chloroplatinite in part of the water, add the phosphoric acid and then add water up to 2 ounces.

Coat the paper, preferably arrowroot-sized water color paper, as described for the regular Kallitype process (Methods 1, 2, 3). After printing the faint image is developed with the acidified silver bath given for those methods.

When the ferric oxalate used is in prime condition, this paper gives a fine black, but if the salt is deteriorated, the image is inclined to brown. Otherwise a good brown color can be obtained at will by reducing the quantity of ferric oxalate in the sensitizer, with a corresponding increase in the amount of iron ammonium citrate.

Brown Tones. A sensitizer giving good brown tones is as follows: Distilled water, 1 ounce; ferric oxalate, 15 grains; iron ammonium citrate, 25 grains; chloride of copper, 8 grains; platinum solution in quantity to suit; bichromate potass solution, 2 to 5 drops; gum arabic, 10 grains.

The resultant image may be developed in acidified silver solution mentioned above, or the printing may be carried to a point where developing is effected by washing the print in water and afterwards fixing in the 2 grains to the ounce hypo solution already advised in the methods already given.

Jarman's Formulas. A similar iron-silver method, giving sepia prints on any hard-sized bond or water-

color paper by simply printing, washing and fixing, was published by A. J. Jarman in "The Bulletin of Photography" a few years ago. I quote:

The Sensitizer is first made up as follows: Distilled water, 4 ounces; iron ammonium citrate (green scales), 200 grains; silver nitrate, 40 grains; tartaric acid, 40 grains; gelatine, 30 grains. Cut the gelatine into shreds and let it soak for a short time in 2 ounces of the water, then add the iron salt and shake the mixture well. Dissolve the silver and tartaric acid in the remaining two ounces of water in a glass flask by the aid of gentle heat. This heating is necessary to obtain complete solution of the silver and tartaric acid without the precipitation of tartrate of silver and also to get the gelatine dissolved.

As soon as complete solution of the silver salt and acid has been obtained, add a small quantity to the iron and gelatine solution, shake the bottle well and add the remainder of the latter mixture. Shake well until complete solution of all the ingredients has been obtained. The mixture is now ready for filtering or straining through a tuft of cheesecloth lightly pressed into the neck of a glass funnel. When filtered it is ready for use.

Coating the Paper. Take a sheet of the paper chosen, mark the back of the sheet with pencil for after identification. Lay the sheet back down upon a sheet of glass, and apply the above sensitizing solution with a camel's hair brush set in rubber or a soft swab as previously described for coating papers. Apply enough of the solution to flow freely over the whole surface of the sheet, permit it to drain from one corner of the paper, then reverse the sheet, making that which was the bottom the top, and place it aside to dry away from actinic light. Postcards may be treated in just the same way.

Printing. When the paper is dry, place it upon a negative. If a postcard, place a black or ruby paper mask upon the negative so as to cut off all other parts up to the edge of the card. Print in a good light until a weak image is formed. A trial or two will determine this. When printed, wash cards or paper in half a dozen

changes of water. It will be observed that as soon as they enter the water the image commences to develop and becomes much darker. As soon as they are washed place them into the following solution.

Fixing. Place them in singly, and turn them over and over. It will be seen at once that they develop to a much darker color and become very vigorous. This solution, which develops and fixes the image at the same time, is made as follows: Distilled water, 25 ounces; hyposulphite of soda, ½ ounce; sulphite of soda (dry), ½ ounce.

About ten minutes in this solution will bring about complete fixing and carry the development to its full extent, after which the prints must be well washed and dried.

It will be observed that when they have become quite dry that they are very much darker than they were when printed. In order to become acquainted with this process, a few trials must be made, so as to enable one to judge the right depth of printing.

Silver-Platinum Paper. An interesting account of the preparation of a paper in which the picture image is composed of silver and platinum is given in the report of a demonstration of Satista, by W. H. Smith, of the English Platinotype Company, before the Croydon Camera Club of 1918. A piece of plain paper was first taken and coated with a 10 per cent solution of ferric oxalate, to which 1-50th grain of potassium chloroplatinite per ounce had been added. This was rapidly dried by heat and exposed under a negative for 2½ minutes close under a 2000 c.p. electric lamp. On development in a normal "platinotype" oxalate developer, only a suspicion of the shadows of the image appeared. For a second experiment, omitting the platinum salt, the same procedure was repeated with a piece of gaslight or development paper. On development, this gave a picture-image of full strength, but the blacks were brownish in hue and high-lights veiled and degraded. As a third experiment, the same procedure was followed as in the second, except that this time the 1-50th grain of the platinum salt was added to the sensitizing solution. The result on devel-

opment was a vigorous print, with intense blacks of good quality and clear high-lights without loss of modelling.

In the second experiment, the high-lights of the picture, said Mr. Smith, were composed of silver, but in the third experiment of silver and platinum, the merest trace of platinum salt sufficing for the reaction. In the manufacture of the paper commercially the proportion of salts is, of course, carefully adjusted, and a sufficient amount of the platinum salt added to ensure a permanent (platinum) image giving all the details of the picture.

A developer suited to these experiments may be made by first preparing a Stock Solution of neutral oxalate of potassium, by dissolving 6 ounces of the oxalate in 20 ounces of hot water, and using 6½ ounces of this Stock Solution, with 1 ounce of potassium phosphate, with water to make a total bulk of solution up to 20 ounces. The phosphate required is the mono-potass salt of the formula KH_2PO_4.

The "Spreader" used by the demonstrator in his experiments, as a substitute for a Blanchard brush in sensitizing the paper, consisted of a piece of swansdown about 3 inches square, doubled over twice, and clipped about a letter clip of the "bull dog" type. A fresh surface of swansdown after use was obtained by folding it the other way, so that a dozen sheets of paper may be coated before replacing the material. It proved a convenient makeshift in the hand-coating of the paper, which is worth noting.

Platinum Paper. The platinotype papers commercially available today are so excellent in quality and reasonable in price, that few readers will care to undertake the somewhat involved procedure of making such papers for themselves. Quite a few pictorial photographers, however, who seek special effects such as can be obtained only with vellum, parchment and Japanese tissues, do prepare their own platinum papers as needed and with considerable success. Most of these, I have been told, follow the method given by Miss Stanbery in THE PHOTO-MINIATURE: No. 96. The method and formulas here given are those of A. J.

Jarman, as published in "American Photography," August, 1910.

In this method Mr. Jarman insists upon the use of a pure, freshly prepared solution of neutral ferric oxalate which registers 70 by argentometer test. This should be purchased and stored in an amber or heavy orange glass bottle. All the operations described are to be carried out in yellow light, as in bromide enlarging.

First make ready the following solutions and mark them *A. B. C. D. E. F.* Solution *A*: Neutral ferric oxalate solution (as described above); Solution *B*: Ferric chlorate, made by mixing 2 ounces of *A* with ½ ounce of potassium chlorate solution containing 1 dram of potassium chlorate to 5 ounces of water. *C*: Chloroplatinite of potassium, consisting of ½ ounce of the salt, in 5 ounces of hot distilled water. Allow to become cold. *D*: ½ ounce of nitrate of lead C. P. dissolved in 5 ounces of boiling water; in fact, boiled in a glass flask until the salt is dissolved. Allow to become cold. *E*: a saturated solution of oxalic acid (Poison). *F*: a thick solution of gum arabic with a few drops of a five per cent solution of carbolic acid added.

Preparation of the Paper. The paper chosen should first be sized, if this is necessary, and dried. For the sensitizing a suitable wooden trough, as wide as the largest sheet to be coated and having a deeply curved bottom, should be made, so that the liquid rests in the center. Both for convenience and economy coat the inside of the trough with two coatings of shellac varnish. Cut the paper into strips, say 8 or 10 inches wide and 20 to 25 inches long; prepare some wooden strips ½ inch wide, 10 inches long, and ⅛ inch thick, varnish these with shellac varnish; also procure about three dozen wood clips (the kind usually employed for photographic use). Make ready a suitable drying closet, in which the coated sheets of paper can be dried by the aid of a gas stove, also fit up another closet lined with blotting paper, which must be well soaked with water, in which the sheets of paper must be suspended, previous to coating, to dampen the paper, to prevent air-bubbles, and ensure an even coating. Take the strips of paper, put a light pencil mark upon the back, then

place one of the wooden strips at the top of the paper, clip it with three clips, fit the bottom end of the paper in like manner, prepare as many sheets as required in the same way, suspend them in the damping box for a short time, and while they are becoming damped prepare the following mixture for coating:

The Sensitizing Solution.—Under orange-colored light mix in the order given: *A*, 3 ounces; *B*, 6 fluid drams; *C*, 3 ounces; *D*, 3 drams; *E*, 30 drops; *F*, 2 drams.

Shake this well in an amber-colored bottle, then filter through a tuft of absorbent cotton pressed moderately in the neck of a 4-inch glass funnel. Allow the liquid to fall into a wide-mouth, amber-colored bottle, with a strip of glass so placed that the liquid falls upon the sloping strip; this will prevent air-bubbles being formed.

When filtered, pour the liquid into the coating trough, take one of the sheets of dampened paper, bend it like the letter J, lower the left hand so that the paper touches the liquid, then lower the right hand, at the same time lift the left hand, allowing the bent surface of the paper to pass over the liquid, return the paper over the liquid by reversing the motion of the hands, lift the paper, drain the excess of the liquid from the lower corner against the side of the trough, wipe the excess from the lower end with a quill camel's-hair brush, then suspend it to dry in the heated closet; the temperature should be 140° F., *not* higher.

Treat all the sheets of paper in like manner; when dry, remove them and lay aside to cool, then repeat the coating, drain, brush off, and dry a second time. When dry, trim off the ends, cut to size, place them carefully rolled and wrapped in a tin case in which a small piece of chloride of calcium has been placed well wrapped in porous paper, close the tin to keep out air until ready for use. The balance of sensitizing solution should be kept in an amber-colored bottle for future use, mixed with new solution for another coating.

Printing the Image. Take any suitable negative, place on the paper prepared side upon the film, cover the front of the frame with tissue paper, expose in bright light until the image is printed to the usual

depth that platinum prints are made. A trial upon a small piece of paper may be made first of all, then develop in the following solution, which should not be higher in temperature than 70° F., as the paper is intended for cold development:

Developer. Potassium oxalate, neutral, 6½ ounces; sodium phosphate, 1½ ounces; hot water, 50 ounces.

Make this in a stoneware crock, stir well with a glass rod, allow to become cold, filter, then use with dilution. Upon inserting the print it will rapidly develop to full density, when it must be placed at once into a clearing acid bath composed of C. P. hydrochloric acid, 1 ounce to 50 ounces of water, allowed to remain for five minutes, then placed in a second bath of like proportions, and a third in which the prints may remain for ten minutes. 1 ounce of chloride of calcium may be placed in the second clearing bath in addition to the hydrochloric acid; this addition is advantageous in the use of all kinds of black platinum prints. After the third acid bath, the prints must be well washed for half an hour, when they may be dried, trimmed, and mounted.

The prints, when dry, will vie in quality with any platinum paper for cold development, and the paper being freshly made, is capable of yielding prints of exceptional beauty. It will be observed, as is the case with all makes of black print platinum paper, that after a number of prints have been developed, the resultant pictures are more brilliant, due to an excess of platinum being dissolved in the developer. For each day's working do not throw away the first-made solution, but add a fresh supply of new developer to that used the day before. This method is not only economical, it is capable of yielding the best prints possible.

Water Developed Platinum Paper can be made with the same chemicals, slightly modified. Having the ferric oxalate made perfectly, those who wish to make some platinum paper for development in hot water can do so by coating some paper with the following solution: Ferric oxalate solution, 4 ounces ferric chlorate, 3 drams; chloroplatinite of potassium solution, 3 ounces; nitrate of lead solution, 3 drams; potassium oxalate

solution (a saturated solution of potassium oxalate), 4 drams; oxalic acid solution, 2 drams; gum arabic solution, 1 dram.

Filter as described, coat the paper, and dry. Prints made upon this paper look paler than the ordinary platinum prints. When the prints are made, pour some hot water into a clean tray, dip the print boldly into this; the image will develop instantaneously. Curious to say, prints made upon this kind of paper will develop themselves if left in a damp place away from actinic light; the image is well brought out in from twelve to twenty-four hours or development can be made to take place by placing the print in the vapor issuing from the spout of a tea-kettle. By this means it is possible to develop the print locally when desired.

After development, clear the prints in weak acid baths and wash, as already described.

Uranium-Silver Paper. A very rapid printing paper which seems to be worthy of record here was worked out by John Bartlett in 1906 and published in "The Camera" for December of that year. I quote: To get the best results with uranium, it is necessary to keep the picture-image as much as possible on the surface of the paper. A suitable sizing of the paper chosen is therefore necessary. After numerous experiments the following method of preparing the paper gave the best results and effectually prevented the image from sinking into the paper.

Sizing. *A*. Soak 30 grains of gelatine in 8 ounces of water until thoroughly soft, then get complete solution by heating up to about 120° Fahr. with stirring. *B*. Dissolve potash alum, 60 grains, and oxalic acid, 8 grains, in 10 ounces of water. Mix *A* and *B* and add 1 ounce of pure alcohol. Immerse the sheets of paper in this solution for three minutes and hang to dry by one corner. When dry, re-immerse and hang to dry by the opposite corner to the first drying. This ensures a uniform coating and a brilliant image is obtained.

Uranium prints are usually made by the printing-out process and the image brought to intensity by a bath of potassium ferricyanide, but this plan does not give straight and good tones, and the print is only pre-

sentable after toning. The color is an unpleasant bistre. We prefer this method of development both on account of the rich color obtained and also on account of the great rapidity by which the impression from the negative is secured.

Uranium combined with silver is not a novelty in printing processes, and the writer does not claim originality in its application. All that is claimed is an adjustment of the proportions and method of development by which an exceedingly sensitive medium is secured which gives pleasing artistic tones and in which an ordinary Welsbach light may be employed for exposures.

Sensitizer. Make the following solution: Distilled water, 8 ounces; nitrate of silver, 275 grains; nitrate of uranium, 4½ ounces. Float the paper on this bath for three minutes and hang it up to dry in a dark chamber. The sensitizing must be done in a dark room.

Exposure. After exposure, which varies from a flash in bright sunlight to five seconds, according to the density of the negative, a strong image may be evolved by development; thirty seconds in diffused light also yields normally good results; from ten to thirty seconds or a minute at six or eight inches from a Welsbach light is sufficient. Dense negatives, of course, necessitate longer exposures. The paper is also sufficiently sensitive to be used for enlargements with electric light. A longer exposure, however, is demanded —perhaps longer than with bromide paper. But as the results are more like platinum printing and the surface perfectly free from gloss, the method recommends itself to artistic workers.

Developer. To develop the prints make the developer as follows: Water, 10 ounces; Proto-sulphate iron, 1 ounce; Tartaric acid, ½ ounce; Sulphuric acid, 1 dram; Glycerine, 1 dram. The image comes up very rapidly and varies from rich brown to black, according to character of negative and times of exposure.

Should there be any tendency of the whites of the picture to overcast by reason of excess of exposure, the addition of tartaric acid to the developer will prevent such clouding.

The tendency from overexposure to veil is prevented by the addition of a small percentage of nickel nitrate to the original coating solution, but while effective in this direction the nickel decreases the sensitiveness of the paper. However, where vigor and brilliancy are desired at the sacrifice of rapidity, the nickel will be found of great advantage, but care must be taken to keep the amount down to a minimum.

A few minutes in a weak acid bath (hydrochloric acid, 1 ounce; water, 80 ounces), and washing in three changes of water completes the process.

Obernetter's Process. Another interesting printing process, allied to those we have been considering, is a method worked out by J. B. Obernetter, published in 1864, and strangely neglected ever since. It gives a variety of tones and colors, from purple to red chalk, and the prints are assured of reasonable permanence.

Paper. A fairly tough, well-sized, hard surfaced paper is advised. This is floated for two or three minutes on the sensitizing solution given below and dried away from daylight. The sensitive paper keeps well before exposure, but not after, so that it should be developed immediately upon exposure or printing. In rapidity it is a little less rapid than print-out paper.

Sensitizer. Obernetter's formula, as modified by Brown, is as follows. Ferric chloride (British Pharm. solution, sp. gr. 1.42), 22 minims; copper chloride, 44 grains; hydrochloric acid, 5 minims; water, 1 ounce.

Print until a faint image is obtained, and develop within two hours by floating the exposed print for three or four minutes on the following developer, then totally immerse the print and let it remain in the developer for from ten minutes to half an hour according to the color required. The image, in the developer, will be faint and weak.

Developer. Potassium sulphocyanide, 5 grains; sulphuric acid, ¼ minim; sensitizing solution given above, 5 or 6 minims; water, 1 ounce. This precipitates cyanide of copper upon the image. After the required time has elapsed, remove the print from the developer and wash it in running water for at least half an hour. In this washing the image will seem to disappear, but

it is there. By immersing the washed print in: Potassium ferricyanide, 44 grains; water, 1 ounce; a rich red or terra cotta tone is obtained. The action of this bath is slow—an hour or more, the strength of the color obtained depending on the time of immersion. When the desired tone is reached, the print may be washed in running water for fifteen minutes and dried.

The late G. Hanmer Croughton, an expert colorist, warmly praised the possibilities of this method for giving rich red prints on a faint gray-blue Fabriano paper, such as would win the admiration of the public if exhibited in the photographer's show or display window. The formulas here given are from Brown's "Ferric and Heliographic Processes," a treasury of *Lichtpausverfahren*.

Blumann's Sepia Paper. I find the method for preparing this paper, under the signature of Sigismund Blumann in "Camera Craft" for October 1914. He speaks of it as giving pleasing prints from negatives having fair pluck and not too much fine detail. The prints are of a rich brown color.

Soak any hard gelatine in water overnight, 6 grains to 1 ounce; next day complete the solution in a double boiler or water bath and, when cooled but somewhat warm, add, in the order given: Tartaric acid, 8 grains; silver nitrate, 9 grains; citrate iron and ammonia, 40 grains.

Filter the mixture through absorbent cotton when thoroughly dissolved. Coat the paper as usual in these methods. Print in diffused daylight, wash in several changes of water and fix the prints in: Water, 2 ounces; hypo, 25 grains. Wash and dry.

The Blue Print. The blue print which plays such an important part in present day activities of an industrial and architectural order dates from the years 1840–42. It was in the year following that in which Talbot divulged his gallo-nitrate of silver method of producing pictures with the camera, upon which is based our present negative process, that Herschel read before the Royal Society a paper describing his method of making blue prints. The beautiful blue resultant from exposure to light is unfortunately not such as

can be used for many photographic subjects. But when the coating is done on a soft velvety-textured paper it lends itself admirably to the recording of cloud forms, white garbed children, and seashore and marine views of a delicate order. For trial prints too in ordinary photographic practice it is effective and inexpensive. When bought of the dealer however this sort of paper is seldom at its best. The coating on a freshly sensitized paper is of a lemon-yellow tint which changes to a green as it ages. As a consequence one cannot get good prints with a paper in the last named condition. Many are not aware of this important fact.

Home Sensitized Paper will not be in good order for more than a few days unless stored in an airtight tube or jar. Under damp conditions it soon spoils. The blue print sensitizing formulas are legion, among the best of them being the following. Brown's formula. *A*: Iron ammonium citrate (green scales), 110 grains; water, 1 ounce. *B*: potass ferricyanide, 40 grains; water, 1 ounce. Mix in equal parts just before using and keep stock solutions in the dark. Filter before use. If the ordinary brown iron ammonium citrate is used the formula calls for 60 to 80 grains of ferricyanide. Millen's formula: Iron ammonium citrate, 1½ ounces; potass ferricyanide, 1 ounce; distilled water, 10 ounces. The solution should be of a deep wine-color and dry on the paper a lemon yellow. Nicol's formula. *A*: Iron ammonium citrate, 3 ounces; water, 4 ounces. *B*: Potass ferricyanide, 2¼ ounces; water, 4 ounces. Just before using mix together one part of each and add two parts water.

The green ferric-ammonium citrate is much more sensitive than the brown and in other respects is greatly to be preferred. It gives a clear solution free from sediment with no tendency to gum-up as does the other. It, however, is not to be found in the stock of the dealer in photographic supplies but can be obtained of wholesale chemical houses.

In Printing the image appears slowly until in appearance it is grayish-blue. Printing should be carried along until the shadows are a grayish-bronze color,

the half-tones being fairly well outlined. To get the best possible results however requires that the coating be fresh. When the printing is completed wash the prints in running water or several changes. In any event the final water should show no trace of blue. Dr. Millen, in marketing French Satin Jr. blue print paper, advised that for particular work one might soak a print over night. Pure whites in fine work are certainly essential, and to attain this the paper not only must be fresh but the washing thorough. Clean crisp negatives of fairly vigorous contrasts give best results in blue printing.

Toning Methods. The ferro-prussiate print may be made to assume a darker but no more pleasing blue by exposing it to the fumes of ammonia. Immersion in a bath containing citric or oxalic acid will bring it back to a much more brilliant blue than it originally had. Over-exposed prints can be reduced by immersion in ammonia water. Bleach to a pale gray, wash for five minutes in running water and re-develop in water, 1 ounce; citric acid, 10 grains. If this is successful the prints will be of a brilliant blue of pale green cast. Oxalic acid brings the same result and when the whites are not pure simply repeat the operation.

F. H. Mason claims to get gray to reddish tones by something like the following procedure: Print somewhat darker than ordinary, wash for ten minutes and immerse in water, 3¼ ounces; copper nitrate, 75 grains; to which is added (a few drops at a time) stronger ammonia until the precipitate first formed is redissolved leaving the solution blue. The print will first turn mauve, then gray, and finally red. It is not adapted for subjects of strong contrast.

There is a patented process for turning a blue print into a black print. Completed in the usual way, the print is immersed in a solution containing a copper salt, which latter is deposited in the blue portions of the image. After washing, the print is immersed in a solution of ammonium sulphide which results in an image of copper sulphide. The copper salt can form part of the sensitizing solution.

S. Purnell finds that a solution of carbonate of soda

(about 2%) reduces a blue print steadily, owing to its slight alkalinity.

Mounting. As good a mountant as any for Kallitype prints is newly made starch paste, or a dextrine paste such as Higgins' Photo Mounter. It is used not too thick and well brushed into the back of the print, which is then laid in position on the mount and lightly pressed into contact. In applying the paste to a batch of prints, care must be taken to avoid rubbing one over another; it is not difficult to injure the image mechanically by abrasion. The best plan is to lay prints face down on a clean glass plate and go over the back of the topmost print with the starch mountant. But, owing to the complete absence of curl in Kallitype prints attachment to the mount by a touch of paste at the two top corners of the print ensures the latter lying quite flat, and for the majority of purposes provides the necessary security. Dry mounting, or the use of a hot iron is not suited to the Kallitype print.

Varnishing. It may often happen that a print which looks rich and brilliant when wet after the final washing, will present a flat, dull appearance in the dark portions of the picture when dry. This lost brilliance may in a great measure be restored by coating the print with a good varnish. Such a varnish is recommended by A. J. Jarman, and consists of a solution of about 300 grains of guncotton in 2 ounces of concentrated amyl acetate. The mixture must be thoroughly shaken, and when solution is complete, carefully filtered through three or four thicknesses of butter muslin. The dried prints are to be dipped one after another in this solution, and then hung up by one corner to drain, and when dry they may be mounted as usual. Doubtless Kodalak would serve as well. E. T. Holding advises a simple solution of wax and turpentine rubbed well into the print. W. J. Warren advises water megilp, applied with a tuft of silk to brighten the shadow detail. As a rule, however, the dull surface or the slight sheen of the Kallitype print, will be approved without further gloss.

James Thomson

Notes and Comment

The Second Annual Exhibition of Pictorial Photography at Seattle, held in the galleries of Fredericks and Nelson, of that city, in November, seems to have been even more successful than the exhibition of a year ago. According to the illustrated report published in *Camera Craft* for December, more than 10,000 persons visited the exhibition, which comprised about 400 prints representing, in many instances, the work of some of the most famous of American pictorialists. We are told that the exhibits, as a whole, showed the growing vogue of diffused or soft-focus effects, with a surprising increase in the number of architectural subjects. Of the thirty-six prizes offered, fourteen went to Californian workers, but the chief award ($100) was given to Mrs. Antoinette B. Hervey of New York, for her "In the Arbor." The work of Rabinovitch, W. A. Alcock and W. H. Zerbe was given high praise, as were the prints of John Paul Edwards, N. P. Moerdyke, Ernest Pratt, John Stick and others familiar on the walls of recent Salons.

J. H. B. Donaldson Enterprises, importers of fine French photographic condensers, have removed their offices to 1501–1507 Broadway, New York. This firm caters especially to the exacting requirements of motion picture operators, optical lantern makers and photographic enlargers, and will gladly advise readers who seek information about condensers for any photographic purpose.

The Chicago Camera Club starts what promises to be an unusually active season with the publication of a monthly bulletin entitled "The Exposure." The November print exhibition comprised a few well chosen examples of the work of Paul T. Karnoski and

Gilbert B. Seehausen, the December exhibition being devoted to the work of Nickolas Muray (New York) and Nels Temte. During the past month the members of the Club spent an evening in the studios and work-rooms of a local motion picture concern, and enjoyed an interesting demonstration of the making of Autochromes, given by Dr. Geo. C. Poundstone.

A Revelation. Despite the fact that most of the pictures admired at our exhibitions are large prints made from small negatives or, in many cases, from portions of negatives, few amateurs realize the pictorial possibilities latent in many "snapshots," which a more frequent use of the enlarging process would reveal. Miles Greenwood, of Melrose, Mass., who has built up a thriving business in developing, printing, and enlarging for discerning amateurs who want the best possible results from their exposures, has recently surprised his clients by a revelation of this sort. Mr. Greenwood's plan is to send an enlarged print with his customer's order when he finds a favorable subject among the exposures sent him for developing and printing. The scheme has met with enthusiastic appreciation—as it deserves.

A Miniature Focal-Plane Camera (Ernemann) just introduced by Herbert & Huesgen Co., of New York, is attracting much attention. It is a fine bit of workmanship, takes pictures 1⅝ x 2½, has a Carl Zeiss lens *f*:3.5 similar to that used in motion-picture work, and shutter speeds to 1-1000th second.

Dunn—The Lens Man, after some years service as lens specialist with a prominent stock house catering chiefly to professionals, has widened his ambition and aims at being "Dunn—the Lens Man" to all the world. Readers seeking special lens service will find it to their advantage to consult Mr. Dunn about their needs. Address Hathaway-Dunn, Inc., 22 East 30th Street, New York, N. Y.

The Roosevelt Memorial Association, Inc., 1 Madison Avenue, New York, N. Y., is seeking original photographs of Theodore Roosevelt and people or events associated with him. Address R. W. G. Vail in care of the Association.

Exposure is still the basic problem in successful photography, with the simplest as well as the most expensive equipment, indoors and out-of-doors. I have tried out the new Milner Light Gauge very thoroughly during the past few months and can recommend it as wholly efficient as an expometer—to coin a much needed word. The simplicity of the Milner Light Gauge is, after its efficiency, its biggest advantage. There are no factors or calculations, no sensitive paper and no eye strain or other inconveniences. It measures the light, indicates the shutter exposure and fits the watch pocket. G. M. Milner, 525 Market St., San Francisco.

New Eastman Specialties worth looking into at your dealers' are Film Developing Hanger No. 4, built on the well-known Core Plate Developing Rack but without the bothersome clips found in earlier film hangers, and made of non-corrosive, rustproof metal; Eastman Portrait Diffusion Disks, converting any studio lens into a soft-focus lens, made in two sizes and in two types for each size, giving different degrees of diffusion; an Adapter Frame Back for studio cameras permitting the use of double film or plate holders; and a Portrait Film Washing-Tank of practical utility, for 5 x 7 and 8 x 10 negatives.

Desensitol is a new chemical product (phenosaframine dye) introduced by Ilford, Ltd., London, which so desensitizes or reduces the sensitiveness of plates as to permit their development in white light. To be precise, ordinary plates treated with Desensitol may be developed by the light of a 16 c. p. incandescent

gas or electric light bulb at 6 or 8 feet, while color-sensitive or panchromatic plates may be safely developed by the diffuse light of an ordinary candle. The red dye is removed from the plate after development. Desensitol may be obtained in America from R. J. Fitzsimons, 75 Fifth Avenue, New York.

"Old Masters." Following a lecture by the eminent painter George Clausen, R. A., in which he praised the work of David O. Hill (1843), Mrs. Julia Cameron (1850), and O. G. Rejlander (1873), the Royal Photographic Society, London, recently held an exhibition of the work of these pioneers in artistic photography. Which reminds me that the December issue of the society's *Journal* contains the best account I have seen of the photographic work of Fox Talbot (1835-1858). This is given as part of the annual address of the President of the Society, Dr. G. H. Rodman, in which he briefly reviewed the evolution of photography from the days of Fabricius and Baptista Porta (1556–1559) to the introduction of the Lumière Autochromes of 1907.

Ceramic Portraits. Edward White, a Kodak dealer of Guantanamo, Cuba, has perfected a simple process for making ceramic photographs, based upon the use of a special carbon paper which gives a vitrifiable picture-image. In order to introduce his process and paper to American photographers, Mr. White offers to furnish a specimen ceramic medallion, without charge, to one professional photographer in each locality, made from a negative to be furnished by the photographer. Professional readers desiring to take advantage of this offer should write to Mr. White for the special circular outlining his proposal.

Portrait Lenses. A new catalogue of "Portrait Lenses for Professional Photographers" has been issued by the Bausch & Lomb Optical Co., Rochester, N. Y. It describes and illustrates especially the new Plastig-

mat portrait lens for impressionistic work; the Tessar Ic, F:4.5, in focal lengths 11¾ to 19 7/16 inches, for studio work and home portraiture; and the Tessar IIb, F:6.3, for portrait groups.

It is often said that the best way by which to obtain a practical knowledge of exposure is to make a few hundred exposures on test subjects, develop the negatives and tabulate the results in a notebook for future use. It may be the best way, but it certainly is laborious and expensive. There is a "short cut," however, in that famous little "Book No. 40," which is given freely and without price, to every buyer of the No. 2 Harvey Exposure Meter. This can be had at your dealers at the nominal price of $2, or direct from Geo. L. Harvey, 105 South Dearborn St., Chicago.

Bromoil enthusiasts will welcome the news that the largest assortment of Bromoil materials and supplies in America is carried by Ralph Harris & Co. the agents for Wellington Bromide Papers, etc. at 26 Bromfield Street, Boston.

Getting the picture properly in focus is one of the three basic factors of successful work with the hand camera. It depends, primarily, upon the skill of the user of the camera in correctly estimating the distance away of the object photographed. Until accuracy of judgment in this admittedly difficult detail is gained by experience, the use of the focusing scale is largely a matter of guesswork. Heyde's Foto-Distance Meter, an ingenious pocket instrument introduced by the Herbert & Huesgen Co. of New York, completely eliminates this formidable difficulty in the use of the hand camera. It is a prism range-finder which, by simply sliding a knob in a figured slot, gives the distance away of any object at a glance. In form it is so compact that it goes easily into the vest pocket, and it is so perfectly adjusted that a child can use it. See it at your dealers'.

Books and Prints

THE AMERICAN ANNUAL OF PHOTOGRAPHY, 1922. Vol. XXXVI. Edited by Percy Y. Howe. 296 pages; profusely illustrated, with 24 plates. New York: George Murphy, Inc.

The quality and interest of the technical papers which crowd the pages of the Annual this year make it a book which no progressive worker in photography can afford to miss. The volume opens with a review of "The Year's Work," by Carrol B. Neblette, Director of the Research Laboratory, Pennsylvania State College. A. H. Beardsley follows with a sensible paper on "Soft-Focus vs Anastigmat Lenses." "The Photography of Maps to Scale", (J.H.Prideaux); "Stereoscopic Photography," (Charles F. Rice); "Bromoil Results," (C.H.Partington); "Photography as Applied to Radiography", (S.A.Schwarz); "Desensitizing", (Henry F. Raess); "Zoo Photography", (A.H.Farrow); "The Bromide Print", (W.A.Alcock); "The Multiple Gum Process", (F.O.Libby); "Lantern Slide Painting", (M.G.Lovelace); "The Optics and Mechanics of Enlarging" (A.Lockett); and a survey of "Photographic Methods of Testing Developers," by J.I.Crabtree are, any of them, well worth the price asked for the Annual. The usual "Formulary and Tables" and "List of Societies" add to the value of the book as a library of reference.

The twenty-four plates, carefully printed in soft browns and green, will cheer the pictorialist, but the illustrations in the text have hardly received justice at the hands of the printer.

PENROSE'S ANNUAL, 1922. Being Volume XXIV of the Process Year Book and Review of the Graphic Arts. Edited by William Gamble. $4. New York: Tennant and Ward, American Agents.

This has just been published in London and will

be ready for delivery in America in February. It is as usual, a splendid bit of book making, printed with exquisite taste and profusely illustrated (one might say, glorified), with examples of all the present-day methods of reproduction. The thirty-odd plates in color are, one and all, extremely interesting and beautiful, representing, in many cases, a notable advance in graphic art. Because of this great wealth of beauty and suggestion, apart from the practical papers which compose the text of the book, the Annual is one which the photographer will enjoy and find profitable for reading and reference.

The British Journal Photographic Almanac, 1922. Edited by George E. Brown. 820 pages, with a photogravure frontispiece. Paper covers, $1; cloth $1.50. New York: George Murphy Inc. American Agents.

Always I think that a fanfare, or other jolly sounding of trumpets, should herald the coming of the "B. J." Almanac, so royal a feast is it! This year Editor Brown, apparently fearful about the digestion of the photographic reader facing the increasing volume of technical and research information published in the journals of today, proposes a course of "Self-Instruction in Photography" as a sort of appetizer. In this, the editorial article of the Almanac, he outlines a series of simple experiments, by which the reader can get a practical acquaintance with the making and use of photographic materials in everyday use. So, beginning with the much talked of but little understood Silver Halides, the Silver Halides and Other Silver Salts in Gelatine, he leads up to the Properties of Emulsion Plates and Papers, the Fixing Process, and the chemical reactions which result in or modify the silver image. Not a dull line in it.

Another section of the bulky volume gives an "Epitome of Progress" in the form of classified abstracts of papers, communications and articles published during the year—"art topics excluded." Following this is a section devoted to "Formulae for the Principal Photo-

graphic Processes," gathering together the standard formulas of recent years. Thereafter is given "A History in Brief (a date and a line of text) of Photographic and Photo-Mechanical Processes," the book ending, as far as the text pages are concerned, with a useful collection of "Tables."

All this and other items chiefly of interest to British readers, such as lists of societies, etc., are sandwiched between some 400 pages of advertising matter, in which latter the American reader will find all that is new in photographic apparatus and materials. Among these I note announcements of Eastman Super-Speed Portrait Film, 700 H. & D.; the Raydex Process for color photography on paper; Barkay Reflectors, increasing the actinic power of studio lamps 700 per cent; Huett Anastigmats (French make); D 50, a new developing agent giving remarkable results in cases of under exposure; a kinematograph camera operated by compressed air, for hand use; the Wray Diffused Image Lens; and a host of other items as yet unknown on this side.

The "B. J." Almanac sells out and disappears from view on publication. It will be ready for American readers when this note appears. The wise will not delay in securing a copy.

Pictorial Landscape Photography. By the Photo Pictorialists of Buffalo. Large 8vo. 236 pages, with 53 illustrations by members of the Society. $3.50. Boston: American Photographic Publishing Co.

This handsome volume, made up of a series of essays originally published in *American Photography*, with a profusion of interesting illustrations and two additional chapters on pictorial printing methods, offers the pictorial worker the most satisfying guide to landscape photography which has thus far appeared. It is reasonable in statement, direct and practical in technical details, simple and human in expression, and the carefully printed plates really illustrate the theories explained in the text.

In the first chapter the writers outline The Nature

and Scope of Pictorial Landscape, as differentiated from other branches of pictorial photography. Thereafter follow chapters on Equipment, Field Tactics, the Negative and Its Enlargement, the Modification of the Negative, Carbon Printing, and the Presentation of the Print. There are also four Appendices:—A. The Color of the Print; B. The Advantages of Small Groups of Workers; C. Multiple Gum Printing; D. Gum Bromide Printing. Formulas and working methods are given throughout, so that the book is as well adapted for the beginning pictorialist as for his more advanced fellow worker. The publishers have given the text an attractive format and the book is well bound in red cloth with a gold title.

Adventures in the Arts. By Marsden Hartley. 254 pages. Cloth, $3.00. New York: Boni and Liveright.

Here we have a delightful book—a series of informal papers on painters and painting, photography, vaudeville and a few poets—which every photographer should get and read for his personal pleasure and inspiration. Marsden Hartley is a critic of reputation in the Arts of which he writes; but this is not a book of criticisms, and does not set out to teach anything or anybody. Quite otherwise, it is a book of the joyous adventures of a fellow mortal who perceives the many-sided beauty of the everyday life about us, and is vividly appreciative of the magic and phantasy of its realities. Its inspirational value lies in the lightness and freshness of the view. It gives us an artist's outlook upon the world of current interests: The Christmas Dances of the Indians of the Rio Grande, Whitman and Cezanne, American painters and painting, the appeal of photography, acrobats and vaudevillians, John Barrymore in Peter Ibbetson, and some poets of yesterday such as Emily Dickinson, Rupert Brooke and Francis Thompson.

The chapter dealing with The Appeal of Photography interested me as a clever summing up of the possibilities of photography as a method of expression limited, as are all the arts, to the presentation of experience. The

work of Alfred Stieglitz, to whom, by the way, the book is inscribed, is cited as confirming the reasonableness of the author's view.

Poems of the Dance. An Anthology. Edited and Illustrated by Edward R. Dickson, with an Introduction by Louis Untermeyer. 263 pages; 16 plates. $3.00. New York: Alfred A. Knopf.

A poet's book this, over-brimming with songs strange and unfamiliar to one, like myself, long accustomed to drier leaves of fact. So—these near two hundred poems of the dance, ranging through early Hindu and Chinese classics (1500 B. C.) Greek, Hebraic, Roman, Medieval, Elizabethan, Victorian, American Indian and latter day (1920) dance expressions, are left to the poets who can best appreciate them.

The pictures, however, are from the dance photographs of Edward R. Dickson and give the book a special interest to pictorial photographers. It is no mean praise to say of these photographs that they are altogether in place among the exquisite word pictures of the poets. Mr. Dickson is gifted with a fine sense of design or pattern, and is further obsessed with the idea that dance pictures should set forth the movement and rhythm of life, the curving and flowing line, rather than diagrams of set figures. It follows that his pictures of the dance have the qualities of the Art they portray—the lilt and pulse of music, a gracious dignity and the lure of beauty.

"The Preparation of Synthetic Organic Chemicals at Rochester" is the title of an illustrated brochure describing the work of the Kodak Research Laboratory, begun in 1918, in manufacturing the numerous but unprofitable series of organic compounds required by chemists for general research and analytical purposes. At the present time the list of Eastman Organic Chemicals, thus prepared or made available, runs to 1144, representing an invaluable contribution to the upbuilding of American research work in organic chemistry.

L'Indicateur de L'Industrie Photographique is the title of a directory of photographic manufacturers, dealers and photographers in France, Belgium and Switzerland, to be published in March, by M. Montel, 35 Boulevard St. Jaques, Paris.

One Hundred Advertisements for Photographers. $3. Cleveland, Ohio: Abel Publishing Co. This is the third series (1921) of this useful work. It offers the busy photographer a collection of brightly written advertisements, ready for use in his local paper or affording ideas and material adjustable to his special needs, sufficient for a whole year. The book is well done and deserves a wide sale.

Pictorial Photography in America, 1922, will not be published until next October, according to a decision of the Pictorial Photographers of America announced at the December meeting. Copies of the first two volumes of this yearbook, 1920 and 1921, can still be obtained.

A recent rotogravure supplement of the *Detroit Free Press* had for its principal feature a delightful page of portraits of children, by D. D. Spellman of that city. It is many a year since Mr. Spellman first sent me examples of his work in this particular field. I am glad to see that his hand has not lost its cunning.

X-Ray Handbooks. In answer to many enquirers, the only recently published works dealing with this field are: "A Manual of X-Ray Work," by Arthur and Muir. Second edition, 1917, $4.00; "A Manual of X-Ray Technique," by Arthur C. Christie. Second edition, 1917. $3.50; and Wendell's "Systematic Development of X-Ray Plates and Films," 1919, $2.00.

Print showing the various stages in the making of a Bromoil

(1) Bleached print. (2) Inking begun. (3A) Inking three quarters completed. (3) Inking completed

SOPHIE LOUISA LAUFFER

IMPERIAL PALACE, VIENNA
From a Bromoil Transfer 7½ x 9½
A. HERZ

Straight Enlargement

Bromoil

IN THE COURT OF THE COLUMNS

WILLIAM GORDON SHIELDS

RELICS OF OTHER DAYS—QUEBEC

From a Bromoil Print, 10 x 13; 4 x 5 Graflex negative

WILLIAM A. ALCOCK

THE OLD HOUSE

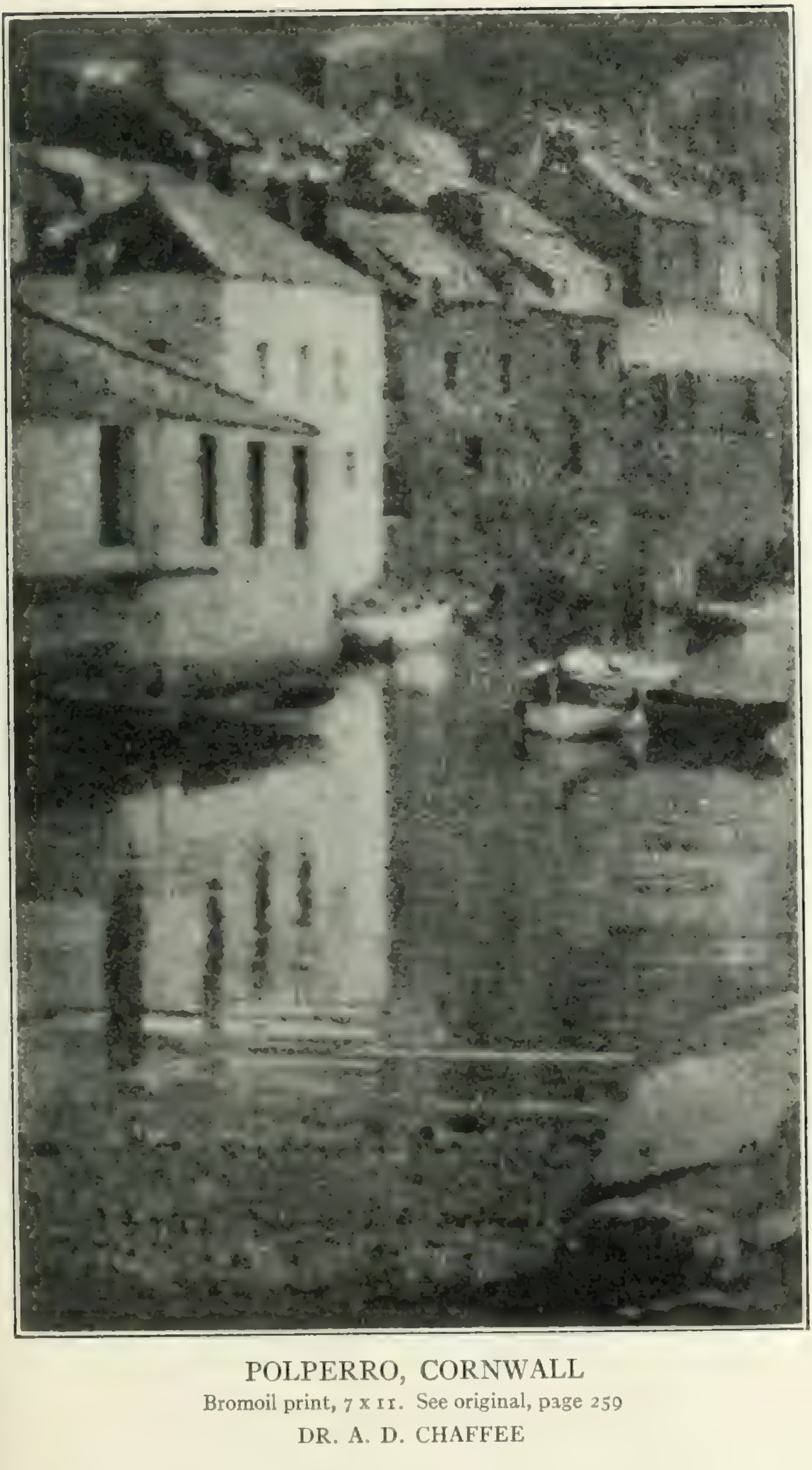
Bromoil 8 x 12, from a Brownie No. 2 negative

SOPHIE LOUISA LAUFFER

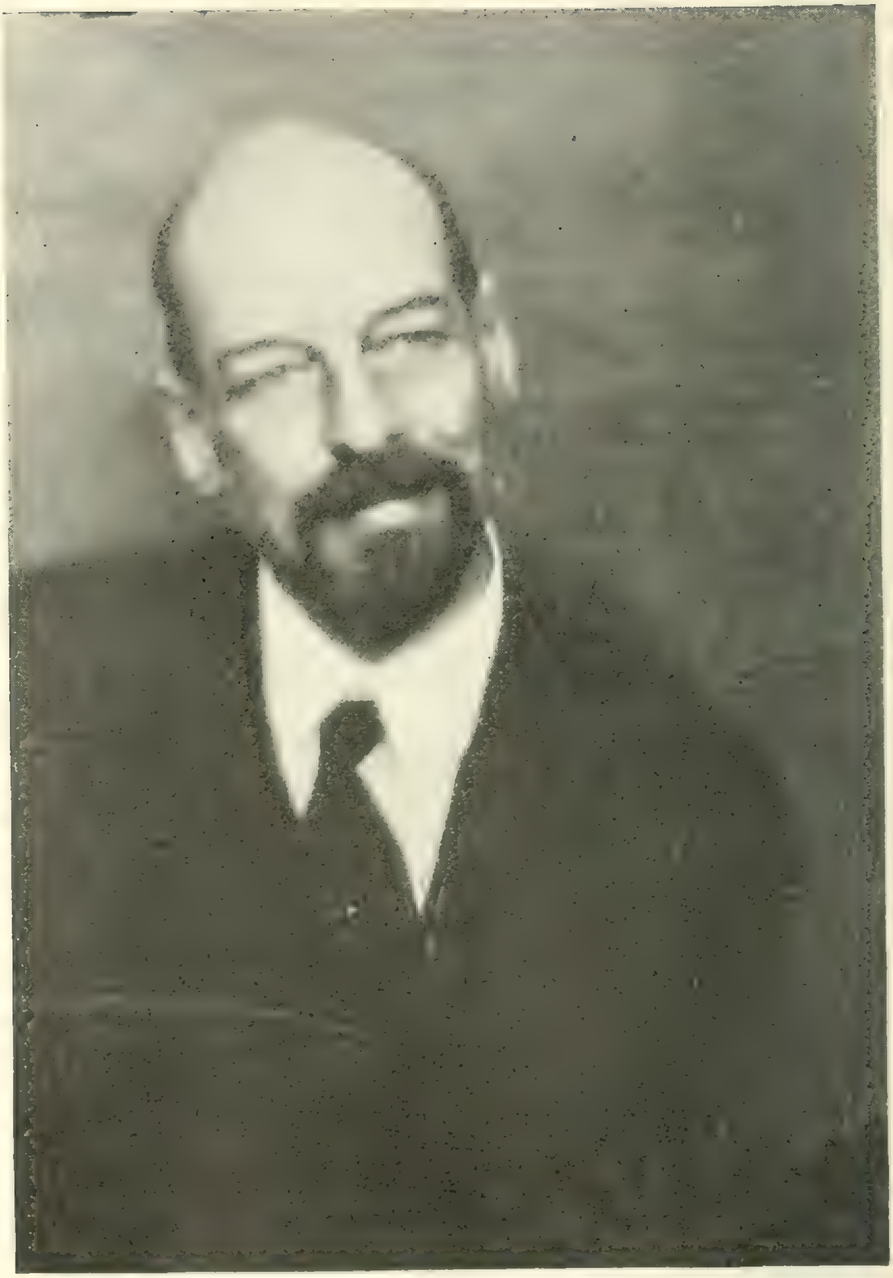
QUIMPERLE, FINISTÈRE

Bromoil 9 x 12, from a $3\frac{1}{4}$ x $4\frac{1}{4}$ negative

DR. A. D. CHAFFEE



POLPERRO, CORNWALL
Bromoil print, 7 x 11. See original, page 259
DR. A. D. CHAFFEE



DR. A. D. CHAFFEE
President of The Pictorial Photographers of America
From a portrait by RABINOVITCH, New York

The Photo-Miniature

A Magazine of Photographic Information

EDITED BY JOHN A. TENNANT

Volume XVI February-May, 1922 Number 186

Bromoil Prints and Bromoil Transfers

The center of interest in photography is the picture-image in the print. As soon as the unrivaled capacity of the photographic process for the production of this image was realized, there arose two schools of photographers: the one seeking to perfect the process so as to secure scientific accuracy in the photographic image; the other seeking to control the process so as to obtain pictorial rather than mere mechanical accuracy in the print. Out of the enthusiastic activities of these two schools have come all the advances made in photography since its beginnings a hundred years ago. The scientific school gives us the technically perfect photograph of today—fact representation by means of the anastigmat lens, the color-sensitive plate or film and the modern development paper. The other school gives us what we know as the pictorial photograph—individual expression rather than mechanical representation, by variation and control in the use of the lens, plate and printing media. The familiar bromide print is typical of the first order; the less familiar bromoil print is the most recent example of the second order.

The bromoil process, then, is a pictorial printing method which has, as its chief interest, the almost unlimited control which it affords over the general character

of and particular effects obtained in the print, together with the possibilities this control offers for individual expression. Obviously such a printing method is for the trained pictorialist who has learned to "see" and "feel," and therefore has a definite impression or individual visualization of his subject to express, rather than for the beginner in photography or the matter-of-fact amateur or professional who desires simply to record the physical facts of his subject in an acceptable way. For these the straightforward development papers offer the best possible media for obtaining in the print all that has been secured in the negative. But for the amateur with pictorial aspirations, who has a cultivated pictorial sense, who knows something of the significance of design in picture making and is sensitive to the subtleties of tone and color values in nature, possessing, withal, a lively imagination and a retentive memory, the bromoil process undoubtedly holds more interest and pleasure than any other printing method in photography.

What is a Bromoil Print? Simply a bromide print, generally an enlargement from a small negative or portion of a negative, in which the developed silver image is bleached out and rebuilt or reconstituted in a fatty ink or pigment which is applied to the bleached print with a brush. It is in this rebuilding of the picture-image in pigment, brush in hand, that the photographer can exercise the control over the finished print which is characteristic of the process. The accompanying illustration shows a "snapshot," with the portion marked which Dr. Chaffee enlarged and from which was evolved the charming bromoil of Polperro to be seen among the pictures engraved for this issue.

This substitution of a pigment image in place of the silver image of the bromide print is as absurdly simple in theory as it is complex and uncertain in practice. It is based on the fact that gelatine will absorb water and swell, in which condition it will repel an oil or fat. When the developed gelatine bromide print is placed in the bleaching solution, this exercises a tanning (drying or hardening) action on the gelatine film in every part of the image where there is silver deposited. This tanning action is proportional to the amount of silver deposited

in the different parts of the image. As a result, when the bromide print thus proportionately tanned (and incidentally bleached) is soaked in water, the swelling and relief of the image will vary with the tanned and untanned areas of the print, and the tanned portions will "take" an oil or fat instead of repelling it as the untanned (and

The "snapshot" from which the bromoil of Polperro, Cornwall, was made

DR. A. D. CHAFFEE

swelled) portions do. If now a colored fatty ink, made by mixing a color pigment with oil, is applied to such a wetted and swelled print we will get a visible record in pigment of the unswelled or tanned portions. This is the pigment image of the bromoil print and it is also a facsimile of the original silver image of the bromide print on which it is based.

The Bromoil Transfer. If, after rebuilding the picture-image in pigment on the bromide print base, as described, we place the freshly inked and wet bromoil print in contact with a sheet of drawing or other paper, under pressure, the pigment image will be transferred to the drawing paper and we will obtain a print in pigment on

paper, similar to the collotype print or photogravure. This is the bromoil transfer.

Let us now get to the actual working of the process: how to make bromoil prints and bromoil transfers. In the instructions here given I have used a monograph prepared for these pages by Adolf Herz, an expert bromoilist who knows the process by long experience and whose prints are equal to the best I have seen. I acknowledge also the generous help given by Dr. T. O'Conor Sloane, Sophie L. Lauffer and William A. Alcock in the translation and revision of the text supplied by Mr. Herz. To Dr. A. D. Chaffee, William Gordon Shields, William H. Zerbe, Ben J. Lubshez and other American workers I offer my thanks for many useful hints and suggestions. May I add that, if the following pages seem to be overcrowded with detail and somewhat tedious in the reading, the reader should remember that the bromoil process, more than any other printing method, depends upon thoroughness and care in every particular, and is much simpler in the doing than in the description.

EDITOR

The Negative. The remarkable possibilities of modification and control offered by the bromoil process have misled some enthusiasts into the belief that the quality of the negative is of little importance in bromoil work. Thus a bromoilist whose prints have been accepted and hung in a dozen salons writes: "All this talk about the negative in bromoil is bunk. Mine are rotten." But a later paragraph in the same note adds, more wisely, "It is axiomatic that in any printing process the quality of the print depends upon the quality of the negative, and this applies with full force to the preparation of the print which is to form the basis of the bromoil." And there you are! A fine bit of hedging.

That the quality of the bromoil print is largely governed by the quality of the bromide print base is certain. An expert worker may succeed in evolving an attractive bromoil even from a poor bromide print. But for the average man the statement that you cannot get a good bromoil out of a poor or imperfect bromide print is much

nearer the truth. And since it is certain that a good bromide print of the sort needed in bromoil work can be obtained only from a reasonably good negative, the quality of the negative obviously has a real importance in bromoil printing. By a reasonably good negative here is meant one fitted by its technical quality to give in the end result or print just the effects desired by the maker of the picture. Let us see what a few bromoilists of wide experience have to say on the point.

Definitions. Adolf Herz says: As most bromoils are made on enlarged prints, the negative should be one which gives a good enlargement in the ordinary sense, not necessarily an "artistic" enlargement, but a clean, crisp print with a long range of tones. An under-exposed plate is especially to be avoided since it will lack detail in the shadows. The plate should be softly developed, if possible without the use of potassium bromide, unless the exposure has been altogether too long. The highlights or densest portions of the negative should be sufficiently transparent to yield detail at these points in the print or enlargement. Clear shadows and opaque highlights are not desirable in negatives intended for bromoil printing. In brief, we need for bromoil work, a well exposed negative with an extended scale of densities or tones, firm in contrasts but free from fog, and sufficiently transparent to show every detail when viewed by transmitted light against a sheet of white paper, in front of which the plate is held as is usual in judging the density of negatives. A well-exposed orthochromatic plate, used with a filter and softly developed, gives a negative of this character; but ordinary plates and films will serve equally well if handled intelligently in exposure and development.

Raymond Crowther, fresh from extended researches in bromoil, is not inclined to compromise. He says: The negative should be of the highest attainable technical excellence and exhibit a full range of tones. It should be correctly exposed and developed.

James A. Sinclair says: Do not think that any kind of a negative will make a good bromoil print. A good negative is essential, especially to the beginner. It should be clean and delicate in character, free from fog and not having great density in any part.

Dr. A. D. Chaffee seeks to obtain in his negative the technical quality and effects desired in the print; so that he rarely, if ever, attempts material change as to these in the making of the bromoil. In his opinion, the chief usefulness of the bromoil process is the facility it offers to the pictorialist for softening or modifying the precise, mechanical character of the "straight" photographic print; for shortening or extending the scale of tones where this is desirable in the presentation of the subject; for subduing or suppressing insistent or distracting detail, and especially as a means of substituting for the somewhat rigid accuracy of the photographic record that vitalizing play of life and imagination which betrays the personal touch and feeling of the maker of the print.

European workers in bromoil favor a softer negative or one with less vigorous contrasts than that preferred by American bromoilists. It is possible that here we have an explanation of the exquisite delicacy and charm of the British bromoils shown on this side in recent exhibitions. Only in rare instances did these British prints exhibit the boldness and vigor characteristic of American bromoils.

Papers. The choice of a suitable bromide paper is an important detail in successful bromoil work today, and the beginner is warned to disregard the looseness of expression as to this point in his reading on the subject. When the bromoil process was first introduced (1907), it was commonly asserted that "any good bromide paper is suitable for the making of bromoil prints." As applied to the bromide papers of that time, and to pre-war papers generally, this was broadly true. But experience quickly proved that, even among these pre-war papers, some were less troublesome in use or gave better results than others. Whereupon careful writers abandoned such misleading generalities and specified the particular papers which had proved satisfactory in their practice.

With the war came radical changes in the quality of chemical materials and methods of manufacture. As one result of these changes, speaking strictly from the viewpoint of the requirements of the bromoil process, the bromide papers of today are very different and behave differently from those of pre-war days. This has naturally resulted in confusion and vexation among the older

workers in bromoil. There is also complaint of a lack of uniformity in the quality of different lots of the same brand of paper, which crops out in unlooked-for difficulties and uncertainty in the successful working of the bromoil process. It is, therefore, impossible at present to name any bromide paper with which success in bromoil printing can be absolutely assured, so that experience is the only safe guide to follow. This, however, does not involve endless change and experiment. The beginner, having chosen his first paper intelligently, is advised to persevere with it, modifying his procedure to meet its peculiarities, and not to change from one paper to another too lightly.

Desiderata. In an interesting discussion of bromoil papers in *The Club Photographer* for April, Dr. A. D. Chaffee says that the ideal paper for bromoil should have an emulsion coating which, with or without visible relief, possesses the quality of acquiring in the bleach a selective affinity for the ink . . . hard enough to withstand the action of the ordinary bleaching formula without melting, crumbling or rubbing up; tough enough or elastic enough to retain the modelling of the image during prolonged and vigorous brush work, and giving an image free from granularity.

Raymond Crowther reporting the investigation of the Bromoil Research Club, in *The Amateur Photographer*, Nov. 30, 1921, says: Papers of the non-stress, over-coated variety are unsuitable for bromoil, as the emulsion is covered with a layer of hardened gelatine free from any image-forming constituents. Papers in which starch or any inert substances have been incorporated in the emulsion are also to be avoided; and paper with an unbaryted base should be selected, as tending to ensure a higher quality level of material as a whole. As an example he advises, for use in England, a paper coated with gelatine of such hardness as will imbibe sufficient water at 60° Fahr. in a quarter of an hour to repel completely the oily ink employed in pigmenting the bromoil image.

Expert Opinion. Lest this discussion of the shortcomings of available bromide papers should discourage the beginner in bromoil printing, a summary of expert opinion is here given to help the reader in his choice of

papers. Incidentally it shows that almost every bromide paper in the market is used by one expert worker or another!

Adolf Herz, the skilled Swiss bromoilist whose experiences and methods make up the larger portion of this monograph, says: As to papers . . . there is no certainty except by trial and proof. I have had success with the *Wellington* Bromoil, *Illingworth* Bromure and *Gaevert*, Nos. 42, 43, 47 and 48 Papers.

S. Grimshaw, an English worker, writing in *The Club Photographer*, Feb. 1922, says: I can vouch for the following after personal trial. *Barnet* Ordinary, Smooth and Rough, and Tiger Tongue; *Kodak* Royal, White and Cream. *Kosmos* Vitegas, 20B and 21B, specially coated for bromoil. This last is a new paper not yet introduced into America. It is said to be a chloro-brom, as distinguished from purely bromide papers, and is classed among "gaslight" or development papers. Its appearance indicates that manufacturers may produce special papers meeting bromoil requirements.

William A. Alcock and Sophie Lauffer, two American enthusiasts largely responsible for the bromoil cult among our Eastern amateurs, advise the use of *Barnet* Platino-Mat in White, and Cream Crayon in Rough natural tinted stock, Tiger Tongue and *Eastman* P. M. C. No. 8; with the Williams Bleach, the Wellington B. B. papers; and, for pictorial work with any copper bleach formula, *Barnet* C. C.

The Brooklyn Institute bromoil group, including many successful exhibitors, use *Eastman* P. M. C. Nos. 5, 7 and 8, with most of the English papers already mentioned. W. H. Zerbe, who has initiated hundreds of amateurs into the mysteries of bromoil, uses *Barnet* and *Wellington* papers.

G. Bellamy Clifton, an English amateur who thinks that "bromoil is not for the many but for the few" because of its distressing uncertainties, prefers the *Ilford* bromide papers as giving him the soft, flat print he desires in the bromide base.

Dr. A. D. Chaffee, the recognized leader among American bromoilists, in the discussion of bromoil papers mentioned above, carefully refrains from specifying any

particular brand or variety, thereby expressing his profound dissatisfaction with all post-war papers.

The Bromide Print which serves as the basis of the bromoil print may be either a direct contact print (if the negative is of the size desired in the finished bromoil), or an enlargement from a small negative. Usually it is the latter since bromoils smaller than 8 x 10 are rarely made.

What about this bromide print? Here again we meet the loose statement: "Any bromidé print will give a bromoil print if you know how to handle it." It may. But it is indisputable that the technical or print quality of the bromoil is largely determined by the quality of the bromide print base. Why, then, risk failure! The better the bromide print, the better the bromoil. More than that, it is agreed that for really successful bromoil work the bromide print should have a certain and special quality of fitness for the requirements of the process. This quality makes for ease and certainty in manipulation as well as quality in results.

What Sort of a Bromide Print? Adolf Herz says: Not what is generally known as a perfect or faultless bromide print or enlargement, but a reasonably good print, somewhat over-exposed and fully developed so that there is a proportion of reduced silver in every part of the image. Pure whites, i.e. portions of the picture-image without silver deposit are to be avoided.

The sort of bromide print, says J. W. Gillies, which will give a good sepia by redevelopment, but not quite as dark as is usual in prints made for redevelopment; that is to say the density is to be obtained by forcing development to a certain extent, so that the silver deposit may extend through the emulsion.

As to this last point Raymond Crowther is not in agreement and states his reason. Mr. Crowther says: The best type of print is one correctly exposed and correctly developed; but not developed right through the emulsion to the paper support since, even in the darkest tones, there should be left a layer of untanned gelatine which will swell in the soaking process and effectively isolate the ink-absorbing surface from the paper support. This renders the removal of ink (pigment) easy and readily controllable when desired in the pigmenting of the bromoil. Most

of the experts insist on full development, giving a print rich in tones and contrasts which look as deep by transmitted light as by reflected light.

The Developer. The bromide print to be used in making the bromoil may be developed in Amidol, Metol-Quinol, Azo (Activol) or Rodinal, but expert opinion is concentrated in the bald statement of Adolf Herz that Amidol is the one best developer for the purpose. He advises the preparation of an Amidol developer as follows: Dissolve 90 grains sodium sulphite (anhydrous) in 20 ounces of water in the developing tray. When the sulphite is completely dissolved, add 15 grains Amidol, which dissolves instantly. The developer is now ready for use.

Hector Murchison's formula, recommended by G. Bellamy Clifton in a recent bromoil demonstration, is as follows: Add 2 fluid ounces of a 10 per cent sodium sulphite solution to 16 ounces of water and, just before use, add to this 8 grains Amidol.

Miss Lauffer's formula is: Dissolve 3/4 ounce sodium sulphite (cryst) in 20 ounces of water; add citric acid 25 grains; potass. bromide 10 grains, and finally Amidol 50 grains.

The reader unaccustomed to handling Amidol is warned that this developer, in powder form as purchased, forms a fine dust with great facility, which will remain suspended in the air for days. Wherever a particle of Amidol dust falls on wet bromide paper, a brownish-black spot results which cannot be removed or remedied. Mix your developer carefully.

Development. As Amidol develops rapidly, it is necessary to secure complete immersion of the exposed print quickly and without hesitation, so that uneven or spotty development of the image is avoided. For sizes under 10 x 12 the tray containing the developing solution is slightly tipped to one side, the dry, exposed paper, coated side uppermost, is pushed or slid under the solution and the tray gently tipped to the other side, so that the exposed print is evenly and completely covered by the sweep of the developer over its surface. Keep the tray in motion until development is complete, which stage is reached as soon as it is seen that the developer ceases to

act. As already indicated, it is important that there shall be a silver deposit over the whole of the image, as the ink (color pigment) will not "take" where no silver deposit remains to receive the "tanning" action of the "bleaching" solution.

Fixing the Print. As soon as development is seen to be complete, the print is rinsed (not washed) in running water and immediately immersed in a plain hypo solution. A bath made by dissolving 8 ounces of hypo in 40 ounces of water is satisfactory. A freshly prepared bath is advised and this should be used only as long as it remains clear and colorless. The print should remain in the fixing bath, preferably kept in gentle motion to ensure the even and thorough action of the solution, for ten minutes to assure the complete dissolution of all the haloid salts (unaltered by exposure) remaining in the emulsion coating of the print. When completely fixed, the print is next thoroughly washed in several changes of water, or running water, so that every trace of hypo is removed.

A Curious Variant. This fixing and washing of the developed bromide print is invariably mentioned by writers on bromoil as the usual and final stage in the making of the bromide print base for the bromoil. It would appear, however, from a paper read by Arthur C. Banfield before the London Camera Club, that when the bromide print is expressly made for this purpose, this fixing may be omitted and the print bleached right after development. Mr. Banfield is reported as saying that "it was much better to bleach the print immediately after developing; there was a considerable saving of time, with a much smaller chance of getting stains. Each print, as soon as fully developed, was placed in a dish of running water, and the accumulated batch then washed for a quarter of an hour. They could then be handled with safety in artificial light, bleached, fixed, and finally washed again for a quarter of an hour in twelve changes of water before being hung up to dry." (Brit. Jour. March 30, 1922).

It is possible that this variant offers advantages as a short cut in the preparation of large batches of bleached prints at one time for later pigmenting. The beginner in bromoil, however, is advised to proceed along the lines of

accepted practice, preparing the bromide print in the usual way and taking up its conversion into a bromoil print as a separate and distinct process.

Drying. Whether the bromide print should be dried at this stage or the actual making of the bromoil commenced straightway on the wet print, is a point about which experts disagree. The general practice up to this time has been to prepare several bromides at one time and convert them into bromoils at convenience any time within a month. Dr. Chaffee tells me that he is still bromoiling a supply of bromide prints made four years ago, before the commercial bromide papers began to show any substantial change in character. It would seem, however, that this drying process has a definite influence upon the "conditioning" of the print for the after pigmenting. Some say that it is necessary where the print is one delicate in tone and detail, i. e. free from heavy masses and presenting a variety of light tones with minimum contrasts.

One plan advised is to lay the washed print face up on a piece of clean, lintless blotting paper, and gently remove the excess of water with a pad of cheese cloth (known to our English cousins as "butter muslin"), then suspending the print by a clip to dry in a current of air away from all dust. Adolf Herz, on the other hand, insists that nothing (fingers, blotting paper or cloth) should come in contact with the gelatine coating at this stage, and so simply hangs the print to dry without treatment. It would seem that this is making "much ado about nothing;" but in bromoil printing the "conditioning" of the gelatine coating of the bromide is the vital point and, as chemists know, every wetting, soaking, swelling and drying of gelatine affects its condition and after behavior.

When the bromide print is dried at this stage it will, of course, be necessary to wet or soak it again before attempting the bleaching operation which forms the initial step in making the bromoil.

Preliminaries. Thus far we have discussed preliminaries—perhaps tedious, but necessary. An outline of the technique of the bromoil process has been given. We know that the bromoil print is evolved from a bromide

print by the substitution of an oily-pigment image for the familiar black silver image of the bromide print. The preparation of a suitable bromide print base has been explained. And we have seen that the interest, usefulness or charm of the bromoil process lies in the possibilities of controlling the interpretation of the subject in the print in this substitution of one image for another. Let us now take up the working of the bromoil process.

Bleaching or Tanning. The first step in the making of a bromoil print is the removal of the visible image of the bromide print base, and the "conditioning" of the print so that it will "take" the ink or pigment which gives us the new image of the bromoil print. This is effected by immersing the print in a solution which simultaneously bleaches out the picture and tans the gelatine coating wherever there is silver deposited, this tanning action being proportional to the amount of silver deposited by development in the various parts of the original but now invisible picture image. The solution so used is known as the bleacher and the operation as bleaching the print, but tanning would seem to be a better term since the proper conditioning of the print for pigmenting (or inking) depends upon this reaction.

By the bleaching process the silver composing the picture-image is reconverted into silver bromide and is therefore susceptible to light action. It is well therefore, to complete the bleaching process either in artificial light or well screened daylight.

Bleachers. There are many formulas for this bleaching or tanning solution, and at least two commercial bleachers which are universally approved as simple and efficient in use. These are the Sinclair and Williams Bleachers, which may be obtained from dealers handling bromoil supplies.

Dr. Emil Mayer's Bleacher is so strongly advised by Adolf Herz as working perfectly with most papers, that I propose to give this formula and the method of its use in detail, afterwards adding other recommended formulas as alternative bleachers.

Prepare the following Stock Solutions. I: Water, 4 fl. ounces; potassium bromide (KBr), 1 ounce. II: Water, 4 fl. ounces; copper sulphate ($CuSO_4$.), 1 ounce. III:

A saturated solution of potassium bichromate ($K_2Cr_2O_7$) in water. For certainty of results the use of "chemically pure" salts and distilled water is advised.

To make the bleaching solution, take 3 parts of Solution No. I, 3 parts of No. II, and 1 part of No. III. To each 5 ounces of this mixture add one drop of concentrated hydrochloric acid. Dilute with 3 parts of water for use. This solution keeps well and can be used repeatedly. As its action is dependent on the amount of hydrochloric acid, it is important that this should be correctly proportioned as given above.

Bleaching. In this method, the dried bromide print is first soaked for half an hour in pure cold water to ensure the complete saturation of the gelatine coating of the paper. Then the wet print is put into a clean tray and the bleaching solution is poured over it. The temperature of the bleaching solution should be between 65° to 85° Fahr. according to the season. A little warmer than the average living room is satisfactory.

In this bleaching solution the picture-image gradually disappears, the process usually being complete in from 3 to 20 minutes (according to the composition of the bleacher, the kind of paper, etc.). Give the bleaching solution time to do its work. The very faint image sometimes remaining after bleaching is completed may be disregarded as merely the secondary color-image of the oxidization products of the developer.

Washing. The print is removed from the bleaching bath and washed for 10 minutes in running water. Note that some workers say "tepid water." Blisters are apt to come if there is any material change in the temperature of the baths and wash waters employed.

The Acid Bath advised for use after this bleaching solution should be previously made up by slowly adding ½ ounce of concentrated sulphuric acid (with constant stirring) to 40 ounces of water. The bleached and washed print is immersed in this and the solution kept in motion for 20 minutes. In this bath the faint image remaining after bleaching quickly and completely disappears.

Variations. The use of this after acid bath, by the way, is peculiar to the earlier bleaching formulas, such

as that recommended by Herz. In the more recent formulas, the acid is incorporated in the bleaching solution, or an acid fixing bath is advised after bleaching and washing. The acid bath after bleaching, however, has its good points, as to remove all traces of the image where bromoils in color are attempted, or to soften an unusually hard gelatine coating, in which latter case the proportion of acid to water is usually 1 to 20. I give a few alternative Bleacher formulas.

Grimshaw's Bleacher. Prepare the two Stock Solutions as follows, I: Water, 30 ounces; copper chloride, 1 ounce; common salt, 8 ounces; hydrochloric acid, 10 minims. II: A. 1 per cent solution of potassium bichromate. For use, take 1 ounce each of Nos. I and II, and add 2 ounces of water.

This bleacher is preferably poured over the dry print (without preliminary wetting or soaking) and, when the image has faded to a pale yellowish-green, the print is rinsed in water until free from yellow stain, which takes from 1 to 3 minutes. It is then transferred to a 5 per cent hypo bath at 75° Fahr. for 5 minutes, after which it is washed in cold (tap) water for from 30 minutes to 3 hours. If it is desired to completely remove all traces of the image, the print is immersed for 1 minute in a 1 per cent solution of Thiocarbamide to each ounce of which 1 drop of sulphuric acid has been added.

Grimshaw's Special Bleacher, for use with the Vitegas chloro-brom papers, is given by Mr. Alcock as follows: Water, 40 fl. ounces; copper sulphate, ½ ounce; potassium bromide, ½ ounce; potassium bichromate, 15 grains; acetic acid (specific quality not mentioned), 10 minims. This bleaching solution is used at 65° Fahr. which temperature is advised for all the baths and waters employed. When the print is bleached, wash for 10 minutes, fix in a 10 per cent hypo solution for 10 minutes and wash for 30 minutes, after which the print is ready for immediate pigmenting, without drying.

W. H. Zerbe's Formulas are as follows: With Wellington Bromoil papers; Water, 14 ounces; copper sulphate, 10 drams; potassium bromide, 10 drams; saturated solution of potassium bichromate, 2 ounces 2 drams; hydro-

chloric acid C. P., 30 minims. For use add 3 parts of water to 1 part of this Stock Solution.

With softer papers or inks the Namias bleacher, amended as follows, is advised: Water, 35 ounces; copper sulphate, 180 grains; potassium bromide, 130 grains; chromic acid, 20 grains. In use both these bleachers are followed by the print being washed for 10 minutes and then immersed for 5 minutes in an acid bath made up by stirring 2 drams of sulphuric acid into 25 ounces of water. After this wash the print for 5 minutes and fix in a 10 per cent hypo solution for 10 minutes. Wash again and hang the print to dry. Do not lay print flat.

Raymond Crowther suggests the following as an ideal bleacher: Crystal copper sulphate 10 per cent solution, 170 minims; potassium bromide 10 per cent solution, 130 minims; chromic acid 1 per cent solution, 45 minims; water to make 3½ ounces. This bath should bleach the image in 3 minutes at 60° to 65° Fahr. After a further minute in the bleacher the print should be well washed and fixed in a neutral fixing bath composed of a 10 per cent hypo solution to each fluid ounce of which has been added 1 grain of potassium metabisulphite. Fix for 5 minutes, wash 15 minutes, and the print is ready for pigmenting without drying or further soaking. If dried before pigmenting, then 5 to 10 minutes soaking of the print will put it into condition for pigmenting.

Edward Clement, in *The Amateur Photographer* of Jan. 18, 1922, reports an extended series of experiments with thirty bleachers and all makes of papers. From the numerous tests made, the following bleacher was selected as being the most generally satisfactory. This conclusion was based on: (1) The print taking the ink readily; (2) the depth and richness of the shadows; (3) the clearness of the highlights; (4) no loss of half-tones or detail; (5) the surface of the gelatine was not rendered tacky; (6) the readiness of the ink to transfer, if desired.

Bleacher (Stock Solution). Pure copper sulphate, (10 per cent solution) 16 drams; potassium bromide (10 per cent solution), 14 drams; potassium bichromate (10 per cent solution), 30 minims; chromic acid solution (1 dr. = 1 gr.), 1¼ drams. For use, 2 ounces of cold water were added to each ounce of the stock solution.

After bleaching thoroughly (3 to 6 minutes) the prints are washed and fixed in acid hypo (2 to 3 minutes), well washed again and hung up until bone dry.

Ferricyanide Bleacher. Before the copper bromide bleacher now universally employed was introduced, a ferricyanide bleacher was the general favorite. This bleacher is more rapid in action than the copper bleacher and calls for a fairly vigorous or plucky bromide print, fully developed. As this ferricyanide bleacher is still used by bromoilists of repute, Dr. Chaffee among them, I give a typical formula. Prepare in five bottles 10 per cent solutions as follows and take for the bleacher: 10 per cent potassium bichromate solution, 4 drams; 10 per cent potassium bromide solution, 2 drams; 10 per cent citric acid solution, 2 drams; 10 per cent potash alum solution, 8 drams; water to make 10 ounces. When the print has been completely bleached in this solution, rinse it in water and immerse in a 5 per cent sulphuric acid bath, made by slowly adding ½ ounce pure sulphuric acid, with stirring, to 10 ounces of water. Rinse the print in five changes of water and fix in a bath made of 1 ounce hypo; ½ ounce sodium sulphite (cryst), with water to 10 ounces. After 5 minutes in this bath wash the print well and it is ready for pigmenting or can be dried for after pigmenting as may be desired.

It would easily be possible to fill this little book with formulas for bleachers, but a sufficient variety has been given for all the requirements of the different papers.

Final Fixing and Washing. Whatever bleacher or bleaching method is employed, and whether the print has been fixed before bleaching or bleached immediately after development, the bleached and washed print must again be fixed and washed before it is ready for pigmenting.

For this final fixing Herz and the majority of bromoil workers advise the immersion of the print for 10 minutes in a plain or neutral (non-acid) bath of hypo, 1 part; water 10 parts. Alcock and some others advise a 5 per cent hypo bath, to each fluid ounce of which 10 grains of sodium sulphite are added. Crowther, as we have seen, suggests that the addition of 1 grain of potassium metabisulphite to each ounce of the 10 per cent hypo

bath is advantageous following the use of the bleacher he advises. He fixes the print for 5 minutes only.

After fixing the print should be washed for 15 minutes. If several prints are washed together, care must be taken to keep them in motion so that each print will be thoroughly washed. At this stage many varieties of paper exhibit a considerable amount of relief, while others seem to lack this relief, but either condition may be disregarded as far as indicating the condition of the print for pigmenting is concerned.

Drying. Most bromoil workers are agreed that the best bromoil prints are obtained from bleached prints which have been slowly and thoroughly dried, and then re-wetted by soaking in water before pigmenting. This is a convenient procedure, since it enables one to prepare several prints for pigmenting at one time, and to take up the actual pigmenting at one's leisure.

Herz insists upon the perfect drying of the print, saying that this drying, with the necessary soaking before inking, has an important influence upon the conditioning of the print. Recalling what has been said of the nature of gelatine, this seems reasonable. He further states that the slower the drying and the longer the print is kept in a thoroughly dry state after bleaching and before pigmenting, the more readily and perfectly will it "take" the ink used in pigmenting and the better the quality of the finished bromoil.

On the other hand there are those who prefer to proceed to the pigmenting or inking of the print right after bleaching, fixing and washing. This, they say, gives prints equal in quality to those by the other method, with the convenience of being able to complete the bromoil in one operation.

The vital point is the proper conditioning of the print. Just when this stage is reached is difficult to describe in type, being a matter of touch or feeling to be acquired by experience. Thus the expert bromoilist can usually tell, by the touch or "feel" of the print, just about how the pigmenting will "go." Grimshaw says: A print in good condition for pigmenting will feel distinctly "slippery" in the highlights, whereas the shadows will feel harsh and rough on drawing the finger across the surface.

The sense of touch or "feel," however, is so differently developed in different individuals that this is but a rough test. In some cases and with some papers the condition of the print can be judged by the relief observable when the print is viewed from a sharp angle. But this is not as reliable as the "feel" test.

Materials for Pigmenting. Before taking up the details of the coloring (inking or pigmenting) of the print, by which the picture image is built up or evolved on the bleached silver image, we must know something about the tools and materials required for this operation. These are brushes (or a roller), oil pigments (fatty inks or colors), and a desk or work table to work upon, with a few sheets of good, lintless blotting paper such as the World Blotter, and a chamois skin or soft (lintless) linen rag for drying the print.

Bromoil Brushes are of a special kind and shape, sold only by the few dealers carrying bromoil supplies, and are made of various materials, generally the hair of outlandish beasts, e.g. sea otter's hair, bear hair, pole cat hair and skunk, usually the last. Other favored brushes are made of hog's hair, fitch and substitute fitch; the common paint store hog's hair brush and shaving brushes are anathema. Sometimes bromoil brushes are sold under the names of the workers who first recommended them, e.g. Mortimer and Demachy brushes; or by their shape, as stag's foot brushes. The quality of the pigmenting brush is important. The best brushes are round in the spread, made of stiff but elastic black hair, with dome-shaped ends cut obliquely, thus resembling a stag's foot. The stiffness and elasticity of the brush is a factor in successful pigmenting; the stiffer the brush, the greater will be the contrast in the print, and the greater the danger of abrading the gelatine surface of the print in applying the pigment.

While the persistent bromoilist can hardly have too many brushes of different sizes and character, a few really good brushes are more to be desired than a large variety of poor brushes. For a start it is suggested that a No. 14 (11-16th inch at the handle) or a No. 12 (5/8th inch) with a few smaller brushes (Nos. 8 and 4) for fine detail will be sufficient for prints of 8 x 10 inches. Large

brushes are preferable as they do the work quicker. A small brush, cut straight at the base and fastened in a quill mount will often be useful.

Rollers. For rapid pigmenting, the obtaining in the bromoil of a perfect facsimile in pigment of the original bromide print or in other cases where a very fine grain is desired, Continental bromoilists apply the pigment to the print with a roller instead of a brush, a method similar to that used in lithography and collotype printing. This practice has not yet obtained a footing among American or British workers, probably because suitable rollers are not available. It goes without saying that the use of the roller does not permit of as large a degree of local control or change in the print as is possible with the brush.

The bromoil roller resembles the familiar roller squeegee used by amateurs in mounting photographs, but the roller is larger in diameter, after the fashion of a lawn roller. It consists of a wooden core or spool 2½ inches in length and ¾ inch in diameter, overlaid with soft sponge rubber about 5/8th inch in thickness, which is provided with an outer covering of thick soft plush to form the inking or pigmenting surface.

Pigments. The quality of the colors, inks or pigments and especially their consistency, i. e. hardness or stiffness or softness, thinness or thickness, are vitally important in bromoil printing. The bromoil image is extremely susceptible or sensitive to the least change in these qualities in the pigments used. If the pigment is too thin the image will be muddy; if too thick or hard the image will be "contrasty."

Theoretically any good "fatty ink," such as printers', lithographic or collotype inks, or oil pigments "made at home" by mixing powder colors with Japan gold size and raw linseed oil, can be used for bromoil pigmenting. But in practice the special inks prepared for bromoil printing will provide a less expensive and more certain way to success. The Sinclair inks and Rawlins' pigments are altogether satisfactory. Charbonelle (Paris), Lechertier Barbe; Ltd. (London) and Horsell (Leeds, Eng.) also offer special inks for bromoil which are warmly recommended, and some American workers have used

successfully the stiff lithographic inks made by Sinclair & Valentine and Ullman Co. of New York.

The beginner is advised to start with Sinclair's "Encre Machine," a hard, warm black pigment which may be softened, if this is necessary, with the addition of a very little "Encre Taille Douce." If brown prints are desired, then Sinclair's "Brown" and "Brown Black" pigments are indicated. For thinning or reducing the consistency of the ink used, Roberson's Medium or megilp is generally advised. All the makers mentioned supply their inks in many colors and in "hard" or "stiff" and "thin" or "soft" varieties. The stiff inks are most desirable for the beginner. The "soft" inks are used to mix with the "hard" for transfers.

As already indicated the consistency of the ink or pigment used must have attention, this varying with the temperature, all inks being thinner in summer than in winter. Difficulties in pigmenting may often be traced to this cause. Thus inks kept in a cold place may be too stiff for successful pigmenting in winter, while during the summer months they will become too thin and give endless trouble. The remedy is to condition your inks according to temperature and secure a normal temperature in the workroom before beginning to pigment.

Worktable. For convenience in working a stoutly built table should be provided, preferably with a "lino" or washable top. A piece of heavy plate glass, papier maché slab or board covered with oil cloth, comfortably larger than the print to be pigmented and firmly set at a slight angle to the table top, is generally used as the immediate support for the print. Since it is essential that the print be kept thoroughly moist during the pigmenting, many workers place on the glass or other support a wetted pad of several sheets of lintless blotter, over which is stretched a piece of absorbent cotton cloth, previously wetted and wrung to get rid of superfluous moisture. On this the wet print is placed for the pigmenting.

Herz simply uses the plate glass slab, without the moist pad, etc. keeping the print in proper condition, if the pigmenting takes longer than usual, by re-soaking it from time to time. Here the practice of the individual worker governs.

For drying the wet print just before pigmenting a piece of absorbent linen cloth or chamois skin is indispensable. If it is linen it must be lintless. Many workers prefer chamois.

Preparing for Pigmenting. We have seen that the successful inking or pigmenting of the bromoil depends wholly on the proper "conditioning" of the gelatine coating of the bromide print base. According to several skilled bromoilists this conditioning is effected by the developing, bleaching, fixing and washing of the bromide print, so that it is ready for inking up immediately after the final washing. On the other hand there are those who insist that a slow and thorough drying of the bleached print is necessary for the proper conditioning of the print for pigmenting.

Before the well dried, bleached print can be inked up, it must be soaked in order to obtain the necessary differential swelling of the image required for pigmenting. For this the print is put into a tray of water at ordinary temperature and soaked until the gelatine coating is completely saturated and a swollen relief image is obtained. Just how long this soaking must be continued cannot be determined generally for all sorts of papers, bleaching solutions and procedures.

Herz says: until the picture-image shows matt on the shining swollen gelatine and that often a visible relief image means that the coating is too much swelled. Sinclair says: I soak the dry print in water at 75° Fahr. from 30 to 45 minutes, then dry and start inking up. Banfield advises 3 minutes soaking at 65° Fahr. or until the print lies perfectly flat and limp. It then holds the minimum of water and is ready for pigmenting with a hard ink. He varies the consistency of his inks according to the amount of water held in the gelatine coating of the print, this varying according to the soaking given. Crowther says that 5 or 10 minutes soaking of the dried print in water at ordinary temperature is sufficient. Zerbe says: soak the print in water at 80° Fahr. until sufficient relief is obtained, which will depend on the make of paper used. And there are those who speak of soaking the print for from 2 or 3 hours to 12 hours at 70° to 80° Fahr.

It is not altogether a question of obtaining a certain degree of relief, but of the proper or differential swelling of the untanned gelatine in the different portions of the picture-image. As to the relief, sometimes an image in vigorous relief will not ink up at all, while others with hardly any visible relief will ink extremely well.

So, the dry print is left in water at ordinary temperature until it is completely saturated and lies flat and limp. This may take a few minutes or half an hour according to the hardness of the gelatine in a particular case.

When removed from the soaking tray, the print is placed, face up, on the wetted blotter pad or glass plate provided as a pigmenting support and carefully dried, by which is meant simply the removal of all excess water from the surface coating of the print. To do this the lintless linen cloth (an old, soft handkerchief is excellent) or chamois is spread evenly over the print and stroked a few times with the palm of the hand. The cloth is lifted off, and the print viewed obliquely in the light to see whether there is any water remaining on the surface. If there is, the drying operation is repeated until the coating is seen to be quite free from any water in streaks or drops. While the print needs careful handling at this stage to avoid breaking the tender gelatine coating, one need not fear good pressure of the hand on the drying cloth or chamois, provided that there is no dragging or rubbing of the surface of the print. It is well to always leave a margin of clear paper surrounding the picture image in the print. This will swell in relief when the print is soaked for pigmenting and protect the edges of the image during the inking.

Pigmenting. Squeeze out a very little stiff ink, about the size of a pea, on an upper corner of the palette or piece of clean waste glass used for this purpose. Spread the ink thinly, with a spatula or palette knife, in a circle of about two and a half inches in diameter. Now dip the points of the brush lightly in the ink, so that the tips of the hairs only are charged with color, and lightly stipple or dab the color on a clean part of the palette. This, with the rubbing of the ink with the spatula mentioned above, works the color to a smooth, homo-

geneous consistency and assures its even distribution on the points of the brush. One should never apply unworked ink on a print as this will surely result in spottiness and uneven coloring.

With the brush thus lightly charged with ink, the parts of the picture image in strong contrast, i. e. where a shadow and a highlight meet, are first attacked. These parts are easily located by means of a pilot print placed alongside the print being pigmented, or by memory or the relief visible in the print itself. In applying the ink the brush is held vertically, plummet fashion, by the end of its handle between the first two fingers and the thumb, so that it hangs vertically over the print and swings freely in any direction.

Brush Action. The touch of the brush or its action on the print is a light tap, thrust or dab, which transfers the ink from the hairs of the brush to the gelatine image where this is receptive of color. Effective brush action is, of course, a matter of individual touch or feeling acquired in practice. The worker will quickly learn the varied effects produced by different touches or handling of the brush, and how to use these to obtain a desired effect or result. Thus a slow "pressing" or caressing touch of the brush, sometimes described as a dragging movement, will deposit a maximum of color, thus producing a heavy tone perhaps desired in the shadows of the print. This touch is generally used where softness is aimed at. On the contrary, quickly repeated dabbing touches, four or five to the second, the points of the brush bouncing as it were without seeming to leave the surface of the print, will deposit a minimum of ink, actually removing it and so tending to contrast, which may be desirable in the lighter tones of the print. Again, this quick bouncing motion with a dry brush will remove still more ink and tend to softness of detail.

As the brush is cut obliquely, the point first touches the paper; the light pressure bends back the hairs of the point, so that the whole surface of the brush comes into play. This slipping or movement of the hairs over the gelatine image is the touch to be acquired, which develops or builds up the pigment image.

In practice the brush should swing freely from the

fingers, always under control and moving in a circular path with a light and rapid stippling motion over the print. When the ink on the brush is used up, this should be re-charged and the pigmenting continued until the whole print is covered and the image appears with its normal contrasts.

If the print, as prepared, is in proper condition for pigmenting, i. e. takes the ink properly, this straightforward inking should give a clean reproduction of the original bromide print. When this is obtained, the happy bromoilist can proceed to exercise the "control" peculiar to the process, adding, taking away, suppressing, "pulling together" or whatever may be needed to secure the pictorial effects desired. The amount of time and work given to this pigmenting varies with the "condition" of the print, the variety of paper ink, etc. employed, the skill of the worker and his ideals as to the finished print. R. Crowther says that a straight bromoil, i. e. a replica of the original bromide, should be perfectly inked up in about 5 minutes, provided the bleached print is in proper condition for pigmenting. Arthur C. Banfield says that half an hour is sufficient for the inking of a 15x18 print. Others, meeting with difficulties in getting the image to "take" the pigment properly, or seeking to obtain certain effects not in the original print, are content to spend from 1 to 3 hours in pigmenting the print.

Re-swelling. If, on this first attempt to ink up the print, the image does not appear, this indicates that the relief is insufficiently developed and a further swelling is necessary. To effect this, the print is removed from the pigmenting support and immersed in warm water at say 80° to 115° Fahr. for 5 minutes. The warmer the water is the more strongly will the relief be developed. With some papers a temperature of 140° Fahr. may be needed; but care is needed at this point as, when once a certain degree of swelling or relief is attained it is difficult to reduce it, therefore it is advised to begin with cold water and increase the temperature of after soakings only if absolutely necessary. An excessive temperature in soaking the print weakens the gelatine for after brush work. Also, the higher the relief of the image, the more abrupt is the tone scale of the finished print and the

stronger its contrasts. Sometimes it is advised to add minute quantities of ammonia, caustic soda or potassium carbonate to the water used for these supplementary soakings of the print, but the action of these alkaline baths is uncertain and often harmful. It is better, therefore, to use water only at various temperatures.

After this re-soaking, the print is replaced on the pigmenting pad and carefully dried with the linen cloth or chamois as before. The brush is very lightly charged with color and the whole surface of the print inked up in the manner already described. This will usually bring up a recognizable image, even though the contrasts may be insufficient. When the print has a light coat of color as the result of this second inking up, it may again be immersed in cold water for a few minutes, replaced on the pigmenting support, dried as before, and gone over with the empty brush (without color) with a light stippling touch. This repeated soaking is very helpful. The development of the picture can be accelerated if the wet image, after the re-soaking, is lightly rubbed over with a dripping wet wad of absorbent cotton before drying and re-inking. This manipulation seems to effect more in a few seconds than working over with the brush will do in some minutes. After treatment with the wet cotton wad the print is dried with the cloth or chamois as before, and observed to see whether the picture-image has sufficient contrast, or whether it is too flat. In the latter case it must be given another swelling in warmer water for a few minutes.

Building Up. When sufficient swelling or relief has been attained, the print is replaced on the pigmenting pad, dried as before and re-inked. The brush is now charged with rather more ink and the shadows in the picture given a sufficiency of color or ink to produce the richness and depth of tone desired. But in all this pigmenting, remember that it is better to apply too little ink at a time than too much. A too thinly inked print, of course, looks thin and mottled in coloring, the richly colored and fine grained print resulting from a generous coating of well worked pigment.

Do not be afraid of going over the print again and again, varying the brush action and the amount of ink

carried by the brush according to the effect desired in different parts of the picture. It is by this continual brush action on the relief image that one obtains the long range of tones and that peculiar richness of effect which distinguish the bromoil from the plain bromide. It is well to use a large brush for this all-over inking-up, reserving the small brushes for local touches, clearing up the highlights and detail work.

Warm water, wet cotton wadding and frequent soaking of the print during pigmenting, all operate to give the picture brilliancy without hardness. Stiff brushes, hard ink, and the use of a roller in place of a brush for applying the pigment have the same effect.

Hopping. The method of brush action known as "hopping" is an aid in helping to increase contrast. In this method, a quick tapping or staccato motion of the brush is used, literally dropping the point of the brush from an inch or so above the print and quickly lifting it three or four times per second, which removes color from the part of the image as treated. A wire holder or "hopper" is obtainable, which so holds the brush in use that the spring of the wire handle facilitates the hopping movement. A too vigorous or prolonged hopping will, of course, break down or abrade the gelatine coating and so ruin the print. Evenness of effect and a fine grain throughout the print are obtained by repeatedly going over the print with the brush very lightly charged with color, or even without recharging it. This also has the effect of bringing out or extending the gradation of the image. Contrast is secured by "hopping."

Dirt. If from new brushes or any other cause the print becomes generally dirty, it can be cleaned by saturating a wad of absorbent cotton with benzine and rubbing this over the print, which will completely wash off the picture. *Don't do this near a naked light.* As soon as the benzine has evaporated, re-wet the print, dry and it is ready for re-inking. This washing with benzine can be repeated without injury. Usually the re-inking after the benzine washing goes faster than in the first pigmenting. Small specks of dirt or hairs can be removed with a pointed bit of soft rubber.

Clearing the Image. When the inking up of the print has been satisfactorily completed, a strong stream of water running over the print will clear the image and impart a soft, velvety quality to the gradations of the picture. For this the print is placed on a sloping board, as in gum-bichromate work and fastened down with pins. A stream of water is then allowed to play over it for a few minutes until the image is seen to be cleared up, after which the print is stretched out to dry.

Control. The control advantages of the bromoil process result from the latitute of manipulation provided in the pigmenting operation. Thus, with a pilot print of the subject alongside, one can restrict the inking or modify it in those parts of the image which need subordination, or heighten the effect where this is desirable. It is, of course, impossible to give definite rules here, where personal taste and feeling alone can guide the worker. But a few technical directions as to controlling the image and in manipulating the ink and brush action may be attempted. Thus the deposit of color and the obtaining of dark tones in the image result from slight swelling, and therefore from the use of lower temperatures in the soaking or swelling baths; from the use of thinner colors (i. e. hard colors thinned with Roberson's medium or soft inks); from softer brushes and the smooth operating of the brush without stippling; from the use of hardened papers and a smaller amount of acid in the bleaching bath. Similarly, the capacity of the image to "take" the colors or ink is diminished, and the picture given a brighter tone, by the use of a stiffer brush or rollers; by obtaining a higher relief or swelling, following the use of high temperatures in the soaking operations; by the use of harder inks; by a vigorous stippling brush action in pigmenting; by more vigorous treatment with the wet cotton wadding; or by light and very rapid movement in the use of the roller.

The Variable Factor. It is here seen that the variable factor is the differential swelling of the coating of the print, on which so much of the after results depend. The means selected to obtain the effects desired must depend on the artistic sense of the worker and his mastery of the flexibility of the process. The same sheet of

paper might be made to give ten different pictures, though all from one and the same negative, in the hands of ten different workers. One might produce a print deep in color but with little contrast or brilliancy, another would give us a hazy or soft transcript of the same subject. The differences would be the direct result of the individual worker's use or control of the factors mentioned above.

Thus far we have spoken of the use of the brush in pigmenting the bromoil. We will now outline the method of using the roller in place of the brush, a variation much favored by European bromoilists.

Using the Roller. The roller employed in bromoil work has already been described. Its use offers the advantages of speed in production and the obtaining of fine-grained prints, but it does not lend itself to local control or individual expression as fully as does the brush. Those who seek to reproduce the original print in facsimile, however, will find the roller a better tool than the brush.

In the use of the roller the bleached print, with a minimum of relief or swelling, i. e. such as will not respond to brush treatment, is first colored or inked up with a large brush. This will not produce a recognizable image as the print has insufficient relief, but it serves to provide an even coating of color. The clean roller is now passed over the print with a medium pressure. After a few passes the whole of the picture suddenly appears in light tones. If this does not occur, the print should be removed from the pigmenting pad and immersed in warm water at 80° to 100° Fahr. to swell the untanned image. After 5 minutes it is replaced on the pigmenting support, carefully dried with cloth or chamois, again inked with the large brush lightly charged with ink, and rolled with the clean roller as before until the image is built up to the desired depth of color.

Or the ink can be thinly spread upon a large piece of glass, about 8 x 10, and the roller inked by rolling it back and forth over the inked surface of the palette, as in lithography, so that it has an even distribution of the color. The print is now gone over with the inked roller until the picture-image is built up. Slow rolling with

moderate pressure brings out the image and gives it good color and richness; quick rolling with a light pressure diminishes the coloring of the print.

Grain. Art work can be done with the roller after considerable practice and those expert in its use have produced beautiful prints. The roller gives a finer grain in the image than the brush, and this tends to richness in detail and depth. This is probably the result of a finer division of the color by the roller than is obtained with the brush. A very pleasing coarse grain effect can be produced if the print is well swollen and then fairly fully inked with the brush. The color is now washed off with benzine and the print gone over with a wet roller. In this method either the roller is wetted or water is poured over the face of the print, with the result that the print is worked up with a mixture of benzine, water and color. After a few passes of the roller and this mixture, a very coarse grained image of characteristic beauty is obtained. The method is adapted for large prints and broad effects.

Drying the Print. When the pigmenting of the bromoil is completed it is firmly pinned down on a clean board and set vertically to dry in a place absolutely free from dust. Necessarily, as the picture-image is formed of an oily pigment, the bromoil dries very slowly. Perhaps after two days drying it may be hard enough for retouching or spotting if these are needed or desired. But in damp or rainy weather the print will or may take a week or two to become thoroughly dry. Banfield speaks of as long a time as three months being necessary in some cases, even under ordinary atmospheric conditions; but he has constructed a low temperature drying chamber (oven) in which his prints, suspended vertically at a temperature of 100° Fahr. dry thoroughly within three days.

Retouching. As soon as the finished print is surface hardened, any retouching, spotting or hand work needed may be started. If the print, for example, is too heavy in tone, i. e. shows too little contrast, the dry picture is wiped over with well wetted cotton wadding. This will brighten up the whole surface and bring out individual lights. Some practice is needed here, but the method is practical and produces results. If this or other after

manipulation spoils the print, it may be soaked in water and all the old inking or color washed off with benzine or carbon tetrachloride (CCl_4) or carbona, and re-inked just as before.

For smoothing out irregularities, working out undesirable light details, and the darkening of local portions, the retouching brush is wetted with benzine and on it, thus moistened, is taken a small quantity of the color used in pigmenting the print. This is worked a little on a piece of waste glass or other palette and then applied to the print, care being taken that the brush is always moistened with the benzine (which evaporates rapidly) and not allowed to get dry.

Dark spots in the print, or portions too dark in tone, may be reduced or removed with a piece of soft india rubber. This is also used for lightly tipping the edges of cloud forms when a sky has been added to a landscape or view in the pigmenting, or for giving an accent in the highlights of the picture. Of course, work of this sort demands an amount of skill and feeling, and must be done with due care. For softening harsh contrasts the ball of the finger rubbed on the print, when it is well hardened but not quite dry, will accomplish wonders. A retouching pen or small etching blade is used for removing hairs or small patches of pigment, grit, etc. from the face of the print. Sometimes these can be rubbed off with a touch of the ball of the finger. By one or other or all of these means the too-light portions may be darkened and the too-dark portions may be lightened in tone; lines softened; obtrusive details suppressed and the whole picture improved.

De-fatting. The oil-pigments used in making bromoils are technically known as "fatty inks." As a result the finished print exhibits a somewhat greasy or semi-glazed appearance. An interesting but little used process may be employed to remove this grease and give the surface of the print a different character. The dry print is put into a clean, dry tray and benzine or carbon tetrachloride is poured over it. After a few rockings of the tray, care being exercised not to touch the surface of the print, the print is removed and dried by suspending it (with clamped ends) in a dry place away from dust. The print,

after drying, can be treated with wet cotton, as already advised, if increased contrasts are desired; but this operation now needs the greatest care as the treated print is much more sensitive to water than before. Retouching, with such a print, is done with a brush and water colors or pastel; broad light effects are obtained with a soft rubber eraser, highlights are cleared or accented with pointed hard rubber or knife. Or the de-fatted print can be cleaned up or brightened generally by the skillful use of a broad piece of soft rubber applied over the whole of the picture. Care and a light touch are essential here.

Cleaning the Brush. The brushes or rollers used in pigmenting may be washed out in benzine, carbon tetrachloride (English bromoilists use petrol), or soap and water. Rollers are easily cleansed by rolling over a plate of clean glass on which benzine is poured. But if bromoils are being pigmented daily it is not advisable to wash the brushes or rollers every day, as a brush without oiliness seems to dirty the print. After washing out, the brushes are best dried by strokes on linen or smooth paper. Both brushes and rollers should be dried in the open air before being used again as any benzine retained in the moist brush will dilute the color at the next inking.

Mounting the Print. Bromoils, being usually made on thick or heavy bromide paper, are not the easiest of prints to mount, especially if they have acquired a slight curl in drying. It is essential that the prints be thoroughly dry and hard. In this condition dry mounting is practicable and perhaps the best method. Or the back of the print is touched with fish glue along the four edges, about an eighth of an inch from the edges, placed on the mount, covered with a glass plate, which is then loaded or weighted and left until the glue is dry. For prints in black or warm black tones a "natural white" mount gives the best effect; for prints in sepia or warmer tones a cream or India-tinted stock may be desirable.

Bromoil Transfers

The highest development of the bromoil process is reached in the production of bromoil transfers, in which, by a simple, mechanical transfer from the bromoil print to another sheet of paper, or any other material which will take the oil color or ink which forms the bromoil image, we obtain a print in pure pigment. This method offers many advantages. The bromoil print serves as a printing plate, as in the photogravure process, and as many as six transfer prints can be obtained from it without the impairment or destruction of the original bromoil. Any kind of paper may be chosen for the support of the transfer, e. g. heavy drawing or cover papers or cardboard (white, cream or tinted) for poster or large portrait work, plate papers, thin Japan tissues or parchments, ordinary writing or ledger papers, and textiles such as silks, etc., so that we can perfectly control the surface texture and ground color of the final picture and get away from the gelatine surfaced papers so generally used in photographic printing processes. It is also possible to transfer the bromoil image to lithographic stone, by the use of litho transfer inks, which opens up the fascinating possibilities of bromoil-lithography. Finally, the bromoil transfer, when successful, gives perhaps the most desirable of prints for large pictorial or exhibition work as well as high class portraiture, approaching the photogravure print in surface texture, depth of color and tone gradation, with the ample margins which add so much to the interest of the fine engraving or photogravure.

The Transfer Process does not present any considerable difficulties to one who has already mastered the more elusive and uncertain art of making a good bromoil print. Briefly outlined it is as follows: A freshly inked (wet) bromoil print is laid face down on a larger sheet of plate or other paper and passed, with pressure, through a roller press. Or the transfer may be pulled in the usual way in a copperplate or lithographic press (if either is available) instead of a roller press. In either

case the pigment image is transferred to the new support, being, in fact, pressed into the fibres of the paper or other support, with the result that we get a facsimile reproduction of the bromoil print, reversed as to right and left, but presenting all the details and tonal values of the original print.

Let us look at the method in detail. If the reversal of the picture as regards right and left is objectionable, the bromide print used as the base in making the bromoil should be reversed. If, as is usual, this is an enlarged print, the reversal is very simply accomplished by placing the negative in the enlarger with the film facing the light instead of the other way as is customary.

The Bromoil Print prepared for transfer making should be one in which a well swollen image with fair relief has given a brilliant and somewhat contrasty print, i. e. a vigorous print, with fully inked shadows and clean highlights. Usually a soft ink is used in pigmenting such a bromoil, or the hard ink advised in earlier pages is very slightly thinned with a soft ink or Roberson's medium. After the pigmenting has been completed, the print should be well swabbed with the wet cotton wadding as previously advised to clean up the lights and brighten the shadows, and then surface dried as usual with the linen cloth or chamois.

The Paper chosen as the support for the transfer should be thoroughly and uniformly dampened previous to the actual transferring. This is usually done before starting to pigment the print, by placing the sheet of transfer paper between several thicknesses of wet blotting paper, with the excess wetness squeezed out, under light pressure, such as a sheet of glass, for about an hour. To avoid the cockling of the sheet during the dampening, it is well to remove the pressure a few minutes after its first application in order to allow the dampened paper to expand evenly, after which the pressure is renewed. Another method of evenly dampening the transfer paper is to immerse the sheet in clean water for a few seconds, passing a wad of wetted cotton over the surface to remove any airbells; then blot the sheet lightly all over and place it between two thicknesses of dry blotter and pass it once through the roller press employed for the trans-

ferring. Different kinds of paper call for different treatment in this dampening or conditioning, the object being to get a uniformly dampened sheet. Some fine matt surfaced papers will give a good transfer without dampening and, for small transfers, many workers prefer to use a dry instead of a dampened paper.

The Press. As indicated a press of some kind is necessary for the making of these bromoil transfers, although I have read of successful small transfers being obtained by hand pressure and the skillful use of a smooth ivory rubbing tool. Good transfers have also been obtained with an ordinary letter copying press, but some form of roller press is generally employed and special presses are provided by Sinclair, of London. Any good roller press will serve, provided that its two rollers are capable of giving an even pressure over the whole of the print when it is put through in contact with the transfer paper. Fred Judge, whose bromoil transfers have delighted the world, used in his earlier work the home mangle or domestic clothes wringer, with its ancient, wooden rollers and central screw pressure. The old-time photographer's burnishing press will serve in a pinch; but one fitted with rubber rollers would be preferable. A copperplate press is also excellent for the purpose and, where available, a lithographic press gives beautiful transfers. In this last case, the wet bromoil print is placed, face up, on the litho stone bed and the transfer paper over the print, with the usual rubber blanket over all before the pressure is applied. The uniform and ample pressure given by the litho press is greater at every part of the print than that obtainable in the roller press, so that a perfect transfer is obtained at one operation. In the use of the roller press, if the first transfer does not give as rich and "juicy" a print as the original bromoil, it is necessary to re-ink the bromoil and make a second transfer, with due care to secure registration in the print before making the second transfer.

A new method of making bromoil transfers, which is an adaptation of the rubber off-set process of printing half-tone blocks, in which a specially devised press is employed, is described by James Rowatt in the February 1922 issue of *The Club Photographer.*

Making the Transfer. Presuming the use of a roller press we need the following accessories: Two sheets of heavy cardboard (or better, two sheets of smooth zinc or metal) twice as long as the longest way of the print and as wide as will pass easily through the press; a few sheets of lintless blotting paper; and a piece of printer's blanket or thick baize larger than the print being transferred.

The bromoil print intended for transfer is supposed to have a clean margin around the pigmented image as a safe edge. After the print is inked up, this margin is wiped clean with a wet rag so as to obtain a clean, straight edge around the picture, and the print is trimmed with a sharp knife or razor blade to provide a margin of ¼ inch with perfectly sharp cut corners.

The sheet of dampened paper is now laid down on one of the cardboard or zinc sheets. The wet bromoil is next laid, face downward, on the sheet of dampened paper, carefully positioned to give the desired margins. Over the bromoil print is placed a sheet of dry blotting paper. This is to absorb the moisture pressed out from the bromoil during the transfer. Over the blotter is placed the printer's blanket and over all the second cardboard or zinc sheet. The whole "sandwich" is now passed twice through the press, that is, once through and back, with a steady, continuous motion and even pressure.

Remove the top layers of the "sandwich," put a fine pencil mark at each corner of the bromoil on the transfer sheet for registration purposes, and carefully strip or peel the bromoil from the transfer support, placing it in a tray of clean water.

Examine the transfer print. If all has gone well it will present a thinly inked but perfect reproduction of the bromoil, lacking, perhaps, sufficient depth of color in the shadows of the subject, but fully detailed, with clear highlights. The required depth or fulness of coloring is supplied by a second or third transfer if needed.

Multiple Transfer. For the second or third transfers the operations described are repeated step by step. Thus the bromoil print is taken from the water, surface dried with the linen cloth or chamois on the pigmenting pad and re-inked with a hard ink. It will usually take

the ink more readily after transfer than in the original or first pigmenting and the re-inking will not occupy more than a few minutes. In this re-inking for the second transfer work for rich, juicy shadows and full contrasts throughout the whole of the print. After inking swab the print with the wet cotton wadding to clear the lights and increase the general brilliancy. Dry with the linen cloth or chamois as before and repeat the transfer operation, using the pencil marks on the transfer paper to secure correct registration before passing the "sandwich" through the press.

Usually, this second transfer will give the print the depth and richness of coloring and effect desired. If however, it is judged to lack quality in any part, this can be remedied by a third transfer. For this the print is again wetted, dried on the pigmenting support as before and re-inked only in those parts where the transfer is judged to lack force or color, after which the third transfer is made as before. These transfer operations, by the way, are extremely interesting and far less tedious or involved in the doing than in the description of the procedure.

It will be obvious that this multiple transfer method offers many possibilities for modification and the introduction of pictorial effects by the variation of the re-inkings. When skillfully handled the transfers far surpass the original bromoil in surface effects, richness of color and tone gradation. The transfer, however, does not exhibit its full effect immediately after coming from the press, the color of the print, its brilliancy and depth of tones gaining in quality as the print dries. As the image is in rather than on the paper, and since this is not gelatinized, the bromoil transfer dries more quickly than the bromoil. Like the engraving or photogravure, its permanency is limited only by the quality of the paper and ink used. If the inks are "fast color" and free from anilines and a pure "all rag" paper is used, the bromoil transfer will retain its good qualities indefinitely and improve with age.

Number of Transfers. Properly handled a single bromoil will yield half a dozen transfers without deterioration, this depending on the character of the bromide

paper base and the resistance of the relief image in the bromoil. Herz says that he has obtained as many as twenty transfers from a single bromoil, but this is exceptional. As soon as signs of wear and tear or deterioration are visible in the bromoil, all transferring should be stopped. When this happens, the bromoil may be wetted, dried and re-inked and serve as a perfectly good bromoil in addition to the transfers obtained from it. Those who make bromoils simply as a means of obtaining transfers, however, wash the print off with benzine as soon as the transfer is made. This restores it to its original condition as a bleached bromide ready for re-pigmenting at any future time either for transferring or as a simple bromoil.

The Retouching of Transfers is confined to brush work with watercolors for the spotting of defects or deepening of shadows, and the use of rubber erasers or an etching tool in the lighter portions of the print. Obviously, also, it is possible to work up transfer prints, where this is desirable, with suitable chalks, crayons or pastel. But the appeal of the bromoil transfer lies chiefly in its quality as a black and white print and the few colored bromoil transfers I have seen have not compared favorably with the monochrome print.

Bromoils in Color. For the sake of completeness, rather than from any desire to urge the reader into perilous adventures, the concluding note of this little book may mention the possibility of making bromoils, and even bromoil transfers, in color. This is not merely a possibility. Multicolor bromoils and transfers in color have been shown at European exhibitions in past years.

For the production of successful work of this sort a a practical knowledge of colors and their handling, such as painters in oils and watercolors possess, is, of course, as essential as a considerable ability in the ordinary bromoil process. Patience and a practised dexterity in brush work are other prime requisites.

As far as apparatus and materials go, those advised for monochrome bromoil work will serve for polychrome printing. The best bromide print for this purpose is one fully developed, with fairly strong contrasts and marked gradation, but varying in general character according

to the subject as to scale of tones etc. For guidance in pigmenting it is advised to have a pilot print of the subject at hand, with color notes, or a water color sketch if this can be provided. It is also recommended that the image be not entirely bleached out, but removed from the bleaching solution when it reaches a light tan color, this providing a guide in applying the color pigments and giving a desirably warm undertone to the print.

As for the pigments or inks employed, the permutations and combinations of color schemes are so variable and numerous that it is difficult to lay down any hard and fast rules. A. H. Dodman says: I get almost any shade of color desired by mixing the so-called primaries—red, yellow and blue—with sepia and black to help out the shadows. J. L. Tucker, in *The Amateur Photographer* of June 17, 1912, says: In the first stage of inking up, use the primaries—yellow, blue, and red only—and get the picture out in these, keeping it as pure as possible; mix a little white with the blue if too strong in tone. Then proceed with the secondary colors—green, purple, orange—still keeping all rich and pure—put the colors on in patches, using always a large brush, and blend and mix them till they give broken tints. Burnt umber is a very useful color, especially for warming greens, or mixed with a tiny quantity of black for the trunks, etc. A beautiful warm grey can be made with this color; a little blue and white for a cool grey black and white; and a still colder grey is obtained by adding a small quantity of blue. It is best to test the color either on the print itself, or on a piece of spare paper, and then modify the print as required.

Where a subject is such as a grey day, a good plan is to mix up a medium tint of this color, and go all over the print with it, modifying it afterwards with transparent colors. and finishing up with sepia or black for the deepest shadows. Black, however, should be used very sparingly, as it soon destroys brilliancy. As the print nears completion look at it from a suitable distance. It will almost invariably be found that certain highlights, such as leaves of trees that have caught the light, bits of sky through the trees, patches of light on a road.

etc., are too prominent, and irritate the eye; they can be subdued with color made to match the surroundings, and diluted with medium. Highlights that have lost their brilliancy can be lightened with a suitable size brush moistened in benzine, with the excess removed by a hopping action. Shadows that are clogged may be cleared in same way, using a larger brush.

After the print is quite dry it is easy to modify objectionable features or tones, and increase the richness by adding carefully transparent color charged with medium; a piece of ink-eraser, sharpened to a point, is useful for increasing highlights.

Polychrome Transfers. When the bromoil in color is intended for transfer, C. F. Stuart advises a fully exposed bromide print with a long tone scale and without excessive contrasts, on a "soft" paper which will take the pigments easily. He uses "soft" inks or pigments, such as copperplate inks or tube oil colors in place of the stiffer lithographic inks, and carries the pigmenting of the print through as rapidly as possible. When the inking is completed the transfer is made as already described for monochrome work, but the transfer paper is used dry, not dampened, and slightly rough papers, such as Whatman, etc. are recommended as taking the colors well in the transfer. In this operation strong pressure is employed, with hard wood rollers in the press, to secure a full color transfer in two passages through the press, i. e. through and back, without subsequent re-inking and re-transfer.

NOTE

The special brushes, inks and other imported materials needed for bromoil work can be obtained from the following dealers: Abe Cohen's Exchange, Inc.; George Murphy, Inc.; J. L. Lewis (New York); Ralph Harris & Co. (Boston); and Hirsch & Kaye (San Francisco). The only handbook to the process available in English is Sinclair's "Bromoil and Oil Prints: How to Make Them. Sixth Edition 1920, $1. Tennant and Ward, New York.

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Lenses—in Use

The first step in all photography is, or should be, the selection of the proper equipment for the work to be done. Equipment here means the camera and lens, with the emphasis on the lens—as it should be. It is the lens which gives the picture. The camera is simply a dark chamber (*camera obscura*) in which the lens projects the picture-image onto the sensitive plate, which occupies the back wall, so to speak, of the camera. But, despite this vital importance of the lens, the camera with its accessories and the sensitive material used have a more powerful influence on the quality of the work done by the lens than is generally appreciated. Lack of appreciation of these factors often minimizes lens qualities and advantages. With a practical knowledge of his apparatus and materials and their relation to the lens, the photographer can produce good work even with indifferent tools. But the best results will be secured, with greater certainty and convenience, in proportion to the quality and adjustment of the equipment, and especially in proportion to the user's knowledge of the capacities and limitations of the lens. For which reason the reader is urged, here, in the beginning, to make sure that his equipment, in design and adjustment, can and will enable him to use his lenses to the limit of their capacity.

First a word about the work done by the lens, its function in making the photograph. This is the formation or projection of an image, on the sensitive film in the

camera, of the objects in front of the camera at the time of photographing. How does the lens form or project the image? Let us consider all visible things as bodies whose surfaces are made up of an infinite number of luminous points, with every point reflecting light-rays in all directions. These light-rays, proceeding from every point in the object, bear images of the points from which they are reflected. When we look at any object, the eye intercepts or collects a number of these image-bearing rays, condenses them to points again or brings them to a focus and re-arranges them upon the retina, thus projecting an image of the external object within the eye, each point making up this picture-image being a counterpart of a corresponding point in the object.

"Pinhole" Images. If we set up a camera, with a focusing screen, facing any well-lighted object out of doors and, in place of the lens on the front of the camera, fix a shield of thin metal or card pierced at its center with a needle (thus forming a needle aperture or "pinhole"), we will get on the focusing screen a true, though inverted image of the objects in front of the camera. It is thus possible to make photographs with a "pinhole"—without a lens. The "pinhole" image, however, is nowhere sharply defined in form and detail, and is so feebly illuminated that a very long exposure is required to impress the picture-image on the sensitive film. The "pinhole," then, is useless for any sort of photographic work where sharp definition and short exposures are essential.

Lens Images. If now we replace the "pinhole" on the camera front with a simple converging (positive) lens, and rack the camera front in and out (from and to the subject), we will get on the focusing screen a picture-image in part at least well defined, and much more brilliantly illuminated than the "pinhole" image, so that we can impress this image on the sensitive film in a fraction of the time (exposure) required by the "pinhole."

This capacity of the lens to bend or converge the image-bearing rays to points, thus giving a sharply defined image, is known as its defining power. The image so formed is projected in an aerial field behind the lens, commonly called the image plane or focal plane. In

photographing, the sensitive film is placed at or within this image plane. The light-transmitting capacity of the lens constitutes its rapidity. The quality of a photographic lens depends on its defining power, i. e. its capacity to bring to points, over a large field or area, the image-bearing rays which it transmits. The rapidity or speed of a lens depends on the volume of light-intensity brought to the image plane or the brightness of the image.

Simple Lenses are discs of glass with highly polished surfaces, at least one of which is curved or spherical in form. They are divided into two classes: positive or converging lenses, which bend the light-rays inward towards the axis of the lens (an imaginary line connecting the centers from which the two surfaces of a lens are struck); and negative or diverging lenses, which bend the rays outward from the axis. There are six possible lens shapes, or seven if we include plano-plates, as follows: Double-convex, as in some view-finders, reading glasses and magnifiers; Double-concave, as in reducing glasses; Plano-concave, used in some direct view-finders; Meniscus lenses have both surface curves facing the same way, and are positive when thicker at the center (like a young moon), and negative when thinner at this point. When the surfaces are plane and parallel we have a plano-plate, as in ray filters. When this type of lens is ruled with a series of concentric circles of mathematical precision, we have a "zone plate," which has a lens action and will give images of a sort. A meniscus, very thin, with equal curves, becomes a "zero focus" lens, like a plano-plate, and has been turned to practical use as a supplementary in "soft-focus" work.

The simple lenses forming a combination or lens system are sometimes called members. Air spaces, separating simple lenses or combinations, are really lens members bounded by the adjacent glasses. Complete lenses or lens systems are also called objectives.

Lens Errors. Simple lenses, although giving an image superior to that given by a "pinhole" in definition and brightness, are defective in so many ways as to be incapable of meeting the requirements of photography. These defects and lack of capacity are due to the errors,

aberrations and faults inherent to all lenses. By the combination of several simple lenses, made of glasses having different optical qualities and varying in surface curvatures, the optician has progressively balanced, reduced, minimized or eliminated these errors. Since, however, all existing lenses are not perfectly corrected, and even the perfectly corrected lenses of today represent compromise rather than finality, it will be useful to consider the principal lens errors and their correction before going further.

Chromatic Aberration is color error: the inability of the lens to converge a ray of white light reflected from a luminous point in the object to a corresponding point of white light in the image, due to the dispersion or separation by the lens of the several color-rays making up the white ray. The light rays which make up the focusing screen image are green and yellow rays, to which the eye is most sensitive. The blue and violet rays, which most strongly affect the sensitive film, come to a focus nearer the lens, and so give confusion circles on the sensitive film instead of points, with the result that a sharp picture can only be obtained on the film by moving the screen image out of the plane of visual focus. By using suitable kinds of glass and proper curves, the optician "achromatizes" the lens and so corrected it is said to be achromatic. Lenses corrected for three or more colors, needed in photo-engraving and color reproduction work, are described as apochromatic. All modern lenses, except a few of the "soft focus" type, are corrected so that the yellow (visual) and blue-violet (chemical or actinic) rays will meet in a precise point in the image plane. In such lenses the chemical and visual foci are said to be identical. It should not be overlooked that lenses may develop temporary chromatic error when used with artificial lights which vary widely from daylight.

Spherical Aberration proceeds from the form or shape of the lens. It is defined as the inability of the lens to bring to a precise point both the central and marginal rays of the same pencil of light. The rays passed by the marginal zones of the lens come to a different focus from the central rays, so that the image is a compound made

up of various focus planes, without sharp definition. This error is corrected by variation of lens curves and the separation of lens members. It is also cured by the use of diaphragms, but this always means loss of speed. The difficulty of correcting this error increases rapidly when lenses are made of large diameter for speed, as in portrait lenses.

When oblique rays are considered, the error is known as zonal aberration or coma. Lenses having this defect do not have the same focus with all diaphragms, an obvious inconvenience in work where precise definition is required with the ability to pick up shadow detail. Point images show fuzzy outlines with a radial comet-like tail pointing outward on the edges of the field. Such a lens is apt to give grey, flat and veiled negatives with blunted image-points.

Curvature of Field. The inability of the lens to give a sharply defined image on a flat plane is due to the error known as curvature of field. All lenses except anastigmats have this error, hence anastigmats are said to have "a flat field," valuable in copying or photographing objects in low relief or lying in one plane. It can be partially corrected by the use of smaller stops.

Distortion. This is due to the varying thickness of the lens and is its inability to reproduce straight lines in the object as straight lines in the photograph. This error exists in all "single" lenses and varies in kind according to the position of the diaphragm, giving barrel-shaped lines when the diaphragm is in front of the lens and pin-cushion shaped lines when the diaphragm is behind the lens. Lenses having this defect are useless for architecture or copying. Lenses corrected for distortion, reproducing straight lines as straight lines are described as "rectilinear" lenses. This form of distortion cannot be cured by the use of smaller stops.

Astigmatism. This is the inability of the lens to give at or near the margins of the field an image of an object containing vertical and horizontal lines in which both lines are sharply defined at the same time. Lenses corrected for this error are said to be anastigmatic and will reproduce marginal points in an object as points in the image. Apart from this correction, anastigmats are

usually thoroughly corrected as to the other errors or aberrations, so that the anastigmat can be depended upon to give a sharply defined image, with a perfectly flat field within a comparatively large angle when used at a large aperture. This degree of correction and perfection explains the higher prices asked for anastigmats as compared with other lenses. Because of its perfect correction and delicately adjusted qualities, however, the anastigmat calls for more careful handling and adjustment of the camera than is required with less perfected types of lenses.

Flare-Spot. All lenses have a flare-spot, but in lens designing the spot is spread over a large area so that it is harmless. When visible it is usually a patch of haze in the center of the negative or on the side of the plate opposite the image of a light object. A slight change in conditions of viewpoint or angle will generally eliminate flare-spot. Night photographs with bright lights included, reflections from sun on window panes, photographing against windows or a bright light, etc. are the extraordinary conditions producing flare-spot. Sometimes in using large aperture lenses which are stopped down this defect will show on white draperies. Similarly when using lenses with the front cell removed a reflection from exposed screw-threads or diaphragm edges may result in flare-spot. Often a pinhole in camera bellows or a leak in the lens front will throw an image on the plate which may be mistaken for ghost or flare-spot.

Lens Terms. A brief definition of some lens terms relating to the properties of lenses will be useful as helping to a better understanding of later pages. A "single" lens is one with two or more glasses cemented together in optical contact. Such lenses are usually achromatic but, except in the case of anastigmatic singles, are not rectilinear. A "doublet" consists of two such "single" lenses with a diaphragm placed between them. Doublets are usually corrected for achromatic and spherical aberration and distortion so that they are said to be "rectilinear." If each element or "single" lens in the doublet is of similar construction and the same focal length the doublet is said to be "symmetrical." If the elements differ in focal length, the lens is said to be unsymmetrical. Anachro-

matic means "non-achromatic," not corrected for color; such lenses give very softly defined images. "Aplanat": a lens corrected for chromatic and spherical aberration, working at a fairly large aperture, without distortion. The axis of a lens is the line connecting the centers from which the two surfaces of a lens are struck. Focus: this word is often loosely used as an abbreviation of focal length. It is the point at which the light rays passing through a lens are converged or brought together to a point. Front and rear combinations are the front and back halves or elements of a compound lens or doublet. Full Aperture: the largest diaphragm or stop with which the lens is fitted. Infinity: A great distance as compared with the focal length of a lens, from two hundred to five hundred times the focal length. The "intensity" of a lens is the maximum speed as indicated by the largest diaphragm aperture fitted to it. Lens mount, tube, barrel or focusing jacket are different names for the metal mounting which carries the lens glasses. Sometimes they are dispensed with entirely and the lens elements are mounted directly in the exposure shutter. Nodal points of admission and emergence are imaginary points in or near a lens, in reference to which the correction of a lens may be traced on the basis that all rays pass out from one point as though they had entered at the other; sometimes called "Gauss points" or "principal points."

Focus and Focal Length. These are two lens terms with separate and distinct meanings, though very generally used to express one and the same thing. "Focus" is really the point behind the lens in which parallel rays, i. e. rays coming from a very distant object, meet after passing though the lens. This is properly called the "principal focus" of the lens. The focal length of a lens is the difference or distance between the principal focus and another point in or near the lens when a distant object is sharply focused.

Scale. The focal length of the lens determines the size or scale of the picture-image. At the same object distance (the distance from the lens of the object photographed) all lenses of the same focal length give images of the same size. The longer the focal length of the lens,

the larger is the image. If the object is very distant, the size of the image is proportional to the focal length of the lens used. Thus, if a lens of 6-in. focal length renders a distant house 1 inch high on the focusing screen, a lens of 12-in. focal length will give an image of the house 2 inches high, from the same standpoint. This rule does not apply in photographing objects comparatively near the camera. Increase in focal length means more weight and bulk in the lens if the speed remains constant, and necessitates increased bellows extension capacity in the camera, as the camera extension must always exceed the focal length of the lens, except in the case of certain telephoto lenses to be referred to later.

In measuring the focal length of the lens, you measure from an imaginary point (the back nodal point or so-called optical center or "focal center") which is often but not always near the diaphragm plane, to the image of a distant object in sharp focus on the focusing screen of the camera. If the image so obtained is the same size as the image which a thin, simple lens would give at precisely the same distance from the screen, your lens has the same focus or equivalent focal length, hence the term "equivalent focus" which simply means "focal length" or "focus" of the lens.

Finding Focal Length. While the focal length of a lens is really measured from an imaginary point, we need not bother with the exact position of this point, as we can find the focal length indirectly by the conjugate focus relations. Thus the difference between distance focus and that focus which gives an image of the same size as the object is practically the focal length of the lens. First focus the lens on a very distant object and then on a scale, getting an image of the latter of the same size as the original; the distance through which the lens must be moved from one position to another gives the focal length. The simplest plan is to use a long bellows camera and mark the two extensions on the bed, the distance between the marks giving the equivalent focus of the lens.

Conjugate Foci. Since the rays reaching the lens from a very distant object are parallel rays, the image of a distant object is sharply focused at the principal

focus of the lens. Images of objects at different distances from the camera, however, necessarily come to a focus at different distances from the lens. Thus for every distance between lens and object there is a corresponding distance between the lens and the image. These two distances (image distance and object distance) are interdependent—as one increases the other decreases—and are known as the conjugate foci or conjugate focal lengths. When the object distance is infinitely great, the other conjugate, i. e. the distance between lens and plate is the equivalent focus of the lens.

Using Conjugate Foci. As the conjugates are the basis of all enlarging and reducing calculations, it will be useful to know how to find them in an emergency. This can be done by using the following simple formula: $F = (r + 1)\, p$ and $f = \frac{F}{r}$. Here F stands for the greater conjugate focal length; f for the smaller conjugate; p is the equivalent focal length of the lens you wish to figure and r denotes the ratio of reduction or enlargement. Ratio 4 means four times linear enlargement; using 1/4 as ratio gives a reduced size image, 1/4 linear reduction. It is simpler to treat r as a whole number and apply the value found according to the nature of the problem. It is obviously lens to object distance in reducing and ordinary photography, and lens to paper distance in enlarging.

For example for a reduction of 4 (1/4 size) with a lens of 8 inches focal length, we have 4 increased by 1, or 5; multiply by 8 and we get 40 inches—the lens to object distance. Divide 40 by 4 and get 10 inches—the lens to plate distance. For an enlargement of 4 times linear, 40 inches would be the lens to paper distance and 10 inches the lens to negative distance. Note that the smaller conjugate is always r times the greater conjugate, e. g. $10 \times 4 = 40$. In copying same size, the ratio is 1 and the formula would read $(1 + 1)8 = 16$ inches extension and $16 \div 1$ or 16 inches lens to copy distance. As the distances are really measured from optical points in the lens, which are somewhat separated, these equal distances (two focal lengths at both sides of the lens) the total distance from the object to plate is not the same as four

focal lengths. It should also be noted that the conjugate relations are modified by the use of filters, and by reversing prisms used in photo-engraving and with commercial copying machines. Conjugate foci tables may be found in any issue of the *British Journal Almanac* and many trade booklets on lenses or enlarging by those who do not care to get the figures for themselves by the formula above given.

As exposure values are based on ratios between diaphragm apertures and focal length, the conjugates must be considered in place of equivalent focal length in figuring exposures in copying and enlarging. Tables giving the required exposures with these variations are available in the yearbooks and in THE PHOTO-MINIATURE: No. 140.

Back Focus, a term sometimes used in lens catalogues, is the distance between the rear surface of a lens to the image when the lens is focused on a distant object. It indicates the minimum extension of camera or bellows required by the lens in use. In some lenses, e. g. the single elements of some Convertibles, back focus is greater than equivalent focus. This has the effect of adding to bellows extension, often advantageous in permitting the use of a shorter focal length with cameras of limited bellows extension, such as reflecting mirror cameras. In such cases the back focus of the lens controls lens fittings. Due allowance must always be made for the projection of the rear cell mounting of the lens used with reflecting cameras, so that the mirror swing clears the lens mount or you cannot focus on distant objects.

Extension Lenses, i. e. special lens elements which, substituted for the normal front element of a doublet, increase the focal length of the complete lens, are furnished by a few lens makers, e. g. Aldis Duo and Trio which increase focal length twice and one-and-a-half times respectively, and the Zeiss Distar which is added to the Zeiss F:4.5 and F:6.3 lenses, extending focal length by 1/3, 2/3 and 3/3, requiring double extension bellows capacity in use.

Covering Power is the capacity of a lens to give a sharply defined image to the edges of the plate it is listed to cover, at its largest diaphragm aperture. The field

illuminated by the lens is circular (the circle of illumination). Any plate whose diagonal is less than the diameter of the circle will be covered, but the quality of the definition within this area will differ in the different zones from center to margins, according to the design and corrections of the lens. If you study the performance of your lens on a large camera, you will note two zones or circles of definition: a large circle of fair definition enclosing a smaller circle of critical definition lying at the center of the field. The larger circle, known as the circle of available definition, is, with some lenses, as large as the circle of illumination. The inner circle is known as the circle of listed definition.

With anastigmats or lenses corrected for curvature of field and other errors which affect the definition of the image on a flat field, the circle of critical definition is, or should be, sufficiently large to cover the plate for which the lens is listed. It is desirable that it should be somewhat larger than this, so as to give a well defined image when the plate is off center, as when the rising or cross front movement is in use, or to permit the lens to be used, with a small stop, to cover a large plate. With some lenses, as you stop the lens down, the area of critical definition is extended beyond the circle of listed definition. With other lenses the circle of illumination shrinks or is cut down by the use of small diaphragms. This needs attention when you use a lens to cover a plate larger than that for which it is listed.

Generally it is an advantage if the lens has extra or reserved covering power as far as the circle of definition is concerned, but too large a circle of illumination is often disadvantageous as resulting in light scatter and flat or veiled negatives.

Flatness of Field. Normally the field of a lens is curved, that is the image points are not focused in a plane, but on a saucer-shaped surface concave side towards the lens, hence it is incapable of giving a flat image of a flat object. This defect, known as curvature of the field, is most evident in old lenses, and may be partially remedied by stopping the lens down, which means loss of rapidity. Modern anastigmats are corrected to give a well-defined image on a flat field at large apertures, which

combination of corrections constitutes their superiority over the earlier types.

Angle of View is a term applying to lenses in use, and is measured between two lines drawn from the center of the diaphragm aperture to the vertical edges (base), or the ends of the diagonal, of the plate. It indicates the amount of view included by the lens. With a plate of given size, the longer the focus of the lens, the less the angle included in the negative, but the scale or image size is the same with lenses of the same focal length. Thus the angle at which a lens works fixes the "drawing" of the picture. Very narrow angles are those around 20°, medium angles around 30°, normal angles around 45° to 60°, wide angles 70° and extreme angles 90° or more. If the focal length of the plate is less than the diagonal or long side of the plate we have a wide angle; if less than the short way of the plate we get an extreme angle. To cover a plate sharply at a wide angle requires special design and construction in the lens, hence we have special lenses sold as wide angle lenses, but such a lens ceases to be a wide angle lens when used on a much smaller plate than that it is listed to cover. Many highly corrected lenses, such as anastigmats, can be used as wide angle lenses on plates larger than those for which they are listed if small stops are used. This means that the lenses have an extra large circle of definition with reserve illumination power.

With large available angle, e. g. the angle at the lens, embraced by the circle of available definition, you can cover a plate which is well off center by the use of sliding or cross front movement or swings. Long narrow panels or square shapes may be included by the same circle, e. g. a post card 3¼ x 5½ in. or a 4 x 5, or a panel 1 x 6 in. as they have the same diagonals. Illumination falls away with extreme wide angles; thus at 90° angle the corners of the plate receive only 25 per cent of the light reaching the central portion of the plate.

The angle of view included by any lens on any given plate can be seen at a glance in Woodman's Table of View Angles, as given in any yearbook, or by the chart by Julius Martin on page 64 of THE PHOTO-MINIATURE: No. 134.

Diaphragm, Aperture, Stop all mean the same thing in speaking of lenses in use. Properly, the diaphragm is a thin plate, usually of metal though any opaque material will serve, with an opening or hole in it, generally circular in shape though for special purposes other shapes are employed, placed between the elements of double or compound lenses, or in front of the lens in the case of single lenses. Since the largest available diaphragm aperture is always smaller than the full open area of the lens itself, the diaphragm serves to "stop" a certain amount of the light which would otherwise pass through the margins of the lens—hence the familiar name, "stop."

Old lenses and some modern lenses used by process engravers have loose or separate diaphragms, known by the name of their inventor as "Waterhouse stops," which fit into a slot in the lens barrel or tube so that the aperture lies across the axis of the lens. In other old lenses a series of apertures of different sizes are arranged on a circular plate which rotates in the lens tube, so that each aperture can be brought into position at the center of the lens as required in use. These are called rotating stops. The most general form, however, is the "iris diaphragm," which consists of a series of thin metal or hard-rubber plates (leaves or segments) within the lens barrel or mount, which open from and close to the center of the lens like the iris of the eye, thus providing a graded series of apertures.

The Purpose of the Diaphragm is twofold: first, to improve the performance or efficiency of the lens in the projection of the picture-image; and to control or regulate the speed or rapidity of the lens in so far as this depends on the amount of light passing through the lens to the sensitive film.

Improving the Lens Action. Very briefly put, the use of the diaphragm improves the general performance of the lens by narrowing the cone of light-rays passing through the lens, so that the picture-image is projected chiefly by those rays which pass through the center of the lens. This directly increases the efficiency of the lens, and minimizes many of the defects which result from the errors or aberrations inherent in all lenses. Thus "stopping down" the lens by means of diaphragm

apertures decreasing in size increases the "depth of focus" or depth of field, i. e. brings objects lying in different planes (at different distances away from the camera) to a reasonably sharp focus in the picture-image. Similarly the use of the diaphragm extends the normally small or restricted area or circle of definition from the center outward to the margins of the plate or sensitive film; gives greater evenness of illumination over the field of definition on the plate; minimizes the blurred or foggy outlines or zones resulting from chromatic or spherical aberration; and reduces the curvature of field and astigmatism existing in the lens. Of course, in anastigmats or highly corrected lenses, where these errors are practically eliminated or corrected by other means, the diaphragm does not play so large a part as formerly in the improvement of the lens action. But even with the most highly corrected lenses the usefulness of the diaphragm as a means of securing "depth" remains unimpaired, the amount of depth secured increasing as the size of the aperture decreases. Obviously the "stopping down" of the lens means a loss of speed or rapidity since the smaller the aperture the less the volume of light passing through the lens.

Diaphragms and Rapidity. The term speed, as applied to lenses in use, refers to the intensity of the light action on the sensitive plate or film. This depends on two factors: the volume of light passing through the lens, and the concentration or intensity of the light when it reaches the sensitive film. The first depends on the size (area, not diameter) of the diaphragm aperture and, as the areas of circles are proportional to the squares of their diameters, varies directly as the squares of the diameter of the apertures. As to the second: the light possesses a certain intensity at the diaphragm aperture, and this diminishes in proportion to the square of the distance between the lens and the sensitive plate. Putting these facts together we get a figure—the ratio of the square of the diameter of the aperture to the square of the focal length of the lens—which will express the relative speed or rapidity of the lens at the different apertures provided by the diaphragm system fitted to it by the maker, and at the same time give us a convenient guide

to the exposures required with the different apertures.

Diaphragm Markings or Numbers. At first diaphragm apertures were arbitrary as to size, and were generally marked 1, 2, 3, 4, etc. from the largest to the smallest. As photography developed different systems of grading and marking apertures were introduced by different lens makers, with some resultant confusion. Of these different systems, the two most generally used with the lenses of today will be briefly described, viz. the F system and the U. S. system.

The F or f/ System. This does not, as some think, mean the "factorial" system, which term applies to a time method for developing negatives, but is the name of the simplest and most widely employed method of adjusting and marking diaphragm apertures—the "focal aperture" system.

In this method the different apertures are marked with fractional numbers directly indicating the ratio of the stop diameter to the focal length of the lens, the effective aperture (the apparent diameter of the aperture as magnified by the front lens) and not the actual diameter being used in this figuring. The series begins with the largest aperture, and is so arranged that each succeeding (smaller) aperture requires double the exposure required with the preceding (larger) aperture or half the exposure required with the next following (smaller) aperture. Thus, supposing the largest aperture has a diameter equal to one-quarter of the focal length of the lens, it is marked F:4 (or f/4). In this way we get a series of diaphragm apertures arranged as follows: F: or f/ number. 4. 5.6 8. 11.3 16. 22.6 32. in which the exposure is doubled with each succeeding (smaller) aperture.

The U. S. System. This means "Uniform System," not United States system as some suppose. It was devised by the Royal Photographic Society and, though officially discarded, is still found on some lenses. This method arranges the diaphragms in the same order as that given above but, beginning with the largest aperture known when the system was introduced, viz. F:4, this was adopted as a unit and marked No. 1, the succeeding (smaller) apertures being marked with numbers which

directly indicated the increase in exposure required with each aperture as compared with that immediately preceding it. Thus F.5.6 was marked U. S. No. 2, requiring twice the exposure required by U. S. No. 1. F:8 was marked U. S. No. 4, requiring four times the exposure required by U. S. No. 1 and twice the exposure required by U. S. No. 2, the series running from U. S. No. 1 to U. S. No. 64. The following table shows the two systems at a glance, with the relative exposures required at the different apertures as above explained:

F: Numbers	4.	5.6	8.	11.3	16.	22.6	32.
U. S. Numbers	1	2	4	8	16	32	64
Relative Exposures	1	2	4	8	16	32	64

The F: or f / values of the upper row have the corresponding exposure values given in the third line of the table, which exactly correspond to the U. S. Numbers in the second line. When F:8 is closed down to F:16, the diameter of the aperture is one-half but the area is only one-quarter and the exposure must therefore be four times as great. The fractional F numbers (eliminated in the U. S. System) come about from the necessity of providing apertures requiring double exposure, quadruple steps being too great. When tables are not available you can figure out any value or exposure as needed by the F: system by dividing the stop you intend to use by any stop for which the exposure is known and squaring the product. One second at F:11.3 is thus equivalent to four seconds at F:22.6. The rule is invariable. If one second were needed at F:22.6, dividing into F:11.3 will give one-half and one-half squared (one-quarter) times the F:22.6 exposure is the new exposure required—one-quarter second.

Identification and Changes. You can recognize the system employed with any lens by noting whether an F: or f / or the figure 1 is engraved before the smallest figure on the diaphragm scale of your lens. To change from U. S. to F: or f / values, multiply the U. S. number by 16 and take the square root of the product: $8 \times 16 = 128$ and the square root is 11.3 (F:11.3). To change F: or f / values to U. S. numbers, square the F: value and

divide by 16: 11.3 squared is 127.69 (128) and 1/16th of 128 is 8 (U. S. No. 8). Mistakes sometimes happen when the exposure figures for U. S. Nos. are used with lenses marked by the F: value system, as when changing from inexpensive hand cameras to one fitted with an anastigmat equipment. Similarly confusion arises from the fact that Continental lenses often bear aperture markings not given in the preceding table. The table following gives the equivalents for these irregular values:

F:	2.2	2.9	3.5	4.	4.5	4.8	5.	5.6	6.	6.3	6.8	7.
U. S.	.3	.5	.8	1.	1.3	1.4	1.6	2.	2.2	2.5	2.5	3.

F:	7.5	7.7	8.	9.	9.5	11.3	12.5	16.	18.	22.6	25.	32.
U. S.	3.5	3.7	4.	5.	5.6	8.	9.8	16.	20.	32.	39.	64.

Speed Ratings. The speed rating of a lens is indicated by the highest stop value (largest diaphragm aperture) at which it is intended to be used, a number or figure marked on the lens mount usually followed by the regular stop numbers in sequence. Thus F:6.3 is followed by F:8; F:11.3 and so on; F:4.5 by F:5.6; F:8; F:11.3 etc. F:6.3 has no place because it does not belong to the standard F: system based on F:4 as unit. Hence the speed rating number, which indicates the maximum rapidity of the lens, does not necessarily bear a regular relation to the other stop numbers. F:6.3, for example, is only sixty per cent faster than F:8 which, in turn, is twice as fast as F:11.3. Properly, when a lens is listed at F:4.5, this is a claim that it will give a sharply defined image from corner to corner of a plate of given size at that aperture. Some lenses will not do this unless a smaller diaphragm is used, so that comparison is not always as simple as it looks. On portrait lenses speed ratings always have a loose meaning as the definition at stated aperture falls away very quickly, and they generally have to be stopped down to give fair definition over a field of reasonable area. Some rectilinear lenses listed as working at F:8 do not measure up to the speed claimed when corner and central definition is a requirement. It should be remembered, however, that extremely large apertures (excess speed) are obtainable only by some sacrifice of either definition or covering power or

both. Thus some anastigmats of extreme speed are restricted as to defining and covering power to the more central parts of the plate sizes for which they are listed, and cannot be effectively used in other than the mountings provided by the maker for the special uses for which the lens was originally designed. For example, an attempt was made to use an F:3 lens of 3-in. focal length (designed and mounted for cinematography) on a camera taking films 1 3/4 x 2 5/16 in. the lens being remounted in a between-lens shutter. So used the limitation as to covering power was plainly evident and the effort to increase the area of sharp definition by the use of smaller apertures resulted in cutting down the illumination circle so far that the corners were not covered at all.

When F: Numbers Mislead. The F: numbers marked on the diaphragm scale do not correctly indicate the speed of the lens and exposure under all conditions, but only when the lens to plate distance is normal or practically at the focal length of the lens, as in photographing distant objects. According to the rule that the intensity of the light action at the plate varies as the square of the distance between lens and plate, so the aperture ratio and exposure change as this distance changes. Thus in copying same size, the lens to plate distance is double the focal length of the lens and the F: numbers marked on the lens for normal use should be doubled, F:8 becoming F:16 etc. The exposures would, of course, vary accordingly. Similarly, in photographing a nearby object, an F:4 lens of 6-in. focal length may require a camera extension of 9 inches. In this case the actual value of the aperture marked F:4 becomes F:6 $\left(\frac{4 \times 9}{6} = 6\right)$ and the exposure should be doubled. The practical rule here is to increase the exposure in the proportion of the square of the increased focal length to the square of the original focal length.

On the tube or scale of doublets whose single elements may be used separately, separate sets of markings are given for the aperture values for both singles and doublet. In such cases only do the apertures of the same number take identical exposures.

Diaphragm Defects. If we photograph an object

having straight lines, such as a building, with a single lens having the diaphragm in front of the lens, all the straight lines near the edges of the picture will be bowed out (barrel-shaped). If the diaphragm is placed behind the lens, the lines will be bowed inwards (pincushion-shaped). This form of distortion results from the position of the diaphragm and cannot be remedied by stopping the lens down. As the distortion does not affect the image at the center of the plate, it may be disregarded as far as the use of single lenses for portraiture, landscape or views of distant buildings coming at the center of the field are concerned, but prohibits the use of single lenses in architectural work or copying. Similarly, this distortion does not occur with the single elements of convertible anastigmats, which are optically corrected for rectilinearity.

Depth of Focus. Probably more discussion centers around this term than about any other lens phrase. You will often hear a man say that this or that lens does not have good depth. "Depth of focus," as generally used, means the ability to bring to a satisfactory focus, or to get a sharply defined image of, objects situated at different distances from the lens. It is sometimes called "depth of definition" or "depth of field" (the preferable term) or "focal depth." Properly speaking, a lens has no depth of focus; that is a lens can only sharply focus objects lying in a single plane at one time. But in practice it is known that by using smaller diaphragm apertures or stopping down the lens, we can obtain depth of focus; that is we can increase the range of distance or depth in the subject within which all objects will be rendered agreeably sharp in the photograph.

Depth of focus, then, is dependent upon the relation between the focal length of the lens and the aperture in use. All lenses of the same focal length, used with a given stop or diaphragm aperture, have the same depth of field. Of two lenses of the same rapidity but differing in focal length, the lens of shorter focal length will have the greater depth of definition. This because the longer the focal length of the lens, the more marked are the differences in image planes. Of two lenses of the same focal length but different in rapidity the more rapid

lens will apparently have less depth of field; but when stopped down to the same rapidity as the less rapid lens, the two lenses will have the same depth of field. It is sometimes said that great depth of focus is inconsistent with rapidity (i. e. large relative aperture) in a lens. But this all depends on the focal length of the lens in use. Thus a 3-in. lens even with an aperture of F:4.5, combines considerable depth with speed, but this is peculiar to lenses of very short focal length. As focal length decreases, depth increases, if the lens to image distance is constant. When lenses of different focal length are used at the same aperture, the lens of shorter focal length gives the greater depth. With lenses of the same focal length the use of smaller stops will give greater depth. With lenses of the same focal length and the same apertures, the distance away of the object being different in the two cases, the lens with the greater object distance will show the greater depth.

Flat objects have no depth of focus, so that stopping the lens down in copying can give no advantage except to minimize any errors or aberrations existing in the lens and so giving increased sharpness of definition.

By using a lens of short focal length and subsequently enlarging the image, you can secure an amount of depth quite impossible with lenses of longer focal length. This is a useful fact to remember when big images and great depth are required at the same time. Where only slight depth is needed, the large aperture of the long focus lens will give results which cannot be duplicated by enlargement of small images as suggested above.

Definition. As depth of focus concerns the obtaining of sharply defined images of objects at different distances from the camera, it may be worth while to consider what we mean by sharp definition. The optician's standard of definition is a "circle of confusion," sometimes called the disc of confusion, the diameter of which represents any point making up the picture-image projected by the lens on the screen or sensitive film. This disc or circle grows smaller as we stop the lens down by using smaller apertures. If the diameter of the circle of confusion does not exceed 1/100 of an inch the negative will have satisfactory definition when viewed at the normal reading

distance. In making small negatives intended for subsequent enlargement, however, this standard of definition is inadequate and the circle of confusion should not exceed 1/250 of an inch. As this means stopping down the lens, the inevitable loss of rapidity must follow.

The depth advantages of small apertures can sometimes be turned to account to permit the use of a long focus lens as a shorter one. With a temporary stop about F:150, you can change the equivalent focal length of a lens in an emergency. Thus a 6-in. lens at F:150 will have a range of from 4 to 12 inches equivalent focus, useful where there is difficulty in getting the lens close enough to the plate for distant focus or in wide angle work.

All depth figures are based on ideal lenses, the practical effects of errors in the lens, the grain of the sensitive emulsion, etc., being ignored. These are sometimes quite considerably and rarely totally absent. It may be that the differences in depth claimed for different lenses of the same focal length and relative aperture are based on these differences in lens corrections, etc.

Hyperfocal Distance is a term much used in depth discussions and hand camera work. It is the distance beyond which everything will be in focus (or reasonably well defined in the picture) when the lens is sharply focused on an extremely distant object or infinity. It increases as the focal length of the lens increases and becomes smaller as the lens is stopped down.

The hyperfocal distance for any given lens and stop may be found by the simple formula: square of focal length multiplied by 100, expressed in inches, divided by 12 times the F: or f/ number, which gives the answer in feet. Thus with an 8-in. lens at F:16

$$\frac{100 \times 8 \times 8}{12 \times 16} = \frac{6400}{192} = 33 \text{ ft.}$$

In hand camera practice it is better to refocus on the hyperfocal point. This gives increased depth zone, the distance sharpness remaining unchanged, but the nearest object in focus advancing to a position one half of distance to hyperfocal point. Sometimes this "near point of satisfactory definition" is miscalled the hyperfocal

point, causing confusion. Taking the example given above, if we refocus on 33 feet, using the same stop, the near depth of field limit will be 16½ feet from the camera.

For finer definition, as in small negatives intended for after enlargement, substitute 250 for the 100, which reduces the disc of confusion to 1/250-in. instead of 1/100 of an inch.

Fixed Focus, sometimes referred to as universal focus, is another term which puzzles the beginner. It simply means the use of a diaphragm aperture so small, with the lens fixed at a certain distance from the sensitive film, that fairly sharp definition of both near and distant objects will be secured in the picture. Lenses so fixed and "stopped down," as fitted to some inexpensive hand cameras, rarely work at greater speed than F:16, the lenses being usually less than 4 inches focal length, so that all objects more than 8 feet away from the camera will be sharply defined in the picture.

This, obviously, is only a practical use of the hyperfocal data already given, and the principle can be applied in the use of any focusing hand camera when this is convenient. Thus, in street views and out-door "snapshot" work generally, with a lens of 5-in. focal length and F:8, if we once correctly focus on an object 26 feet away, or set the focus scale mark at 25 feet, the camera will give us sharply defined pictures of all objects more than 15 feet away, so long as we use the lens at the same position and with the same stop.

Types of Lenses. Among simple lenses the positive *meniscus* gives the best images and such lenses are used on inexpensive fixed-focus cameras, being fixed at sharp position to compensate for lack of color correction. Their speed rating is low, F:16 and they work well only on small sizes.

The single achromatic lens has two or more members of suitable glasses and curves to correct color error. The section is usually of positive meniscus form, hence they are listed as *achromatic meniscus*. Old landscape lenses are of this type and give brilliant images, though not rectilinear. What we use today as single achromats are the half combinations of doublets, called "halves" or

"singles." Their speed is usually around F:14, but with high correction may go as high as F:12.5, and still higher in the case of some F:4.5 and F:5.6 doublets.

Rapid rectilinears are doublets, usually made up of two opposing single achromats with the diaphragm between them, this construction eliminating the distortion of the singles. When the elements are equal in focal length the combination or complete lens is symmetrical, when these are unequal it is said to be unsymmetrical. Some rectilinears are convertible, i. e. you can use either one or both of the single elements separately or the complete lens at will, giving choice of focal length.

Anastigmats are perfected or corrected rectilinears, designed to give precise definition with freedom from distortion or error on a flat field at large apertures. Because of their higher efficiency, they are replacing the earlier rectilinear type for almost all purposes in photography. The greater their rapidity, the greater the care necessary in their fitting, adjustment and handling in use. As a rule moderate speed anastigmats have more reserve covering power and are more generally useful than those of extreme speed.

Portrait lenses are usually of the Petzval type in construction this giving a brilliant image within a restricted area with marked plane separation, producing roundness or relief in the image. Anastigmats are, however, largely used in portraiture today. *Pictorial lenses* are usually diffuse or soft-focus types, giving images generally soft in definition, due to lack of complete correction of chromatic and spherical aberration.

Telephoto lenses are either negative lens attachments for use with ordinary positive lenses, or complete lens systems, designed to give large images with relatively short bellows extensions, the size of the image varying according to the separation of the lenses. *Fixed-focus telephoto* means a lens of non-variable separation, giving only one magnification, focused in the ordinary way and used with cameras of short bellows capacity.

Condensing lenses (condensers) are used in enlarging. *Supplementary lenses* modify the focus of existing lenses to which they are attached. *Projection lenses* are types used in lantern slide and motion picture projection.

Air-space lenses are types in which the elements are not cemented, but separated by air spaces which, of themselves, serve as lens elements in the complete system. This type of construction does not necessarily mean that the lens is unsymmetrical. A *quartz lens* is a lens made up of quartz instead of optical glass, to gain speed by the transmission capacity of quartz for ultra-violet rays.

Convertible Lenses. With convertible types, you have the added facility of working with either the complete lens or the single element, giving two lenses in one, really three lenses, because when stopped down, the doublet is a wide angle lens on larger plates. The long focus lenses give larger images in proportion to their focal length but if plate size is not changed, the angle included is less.

Goerz Dagor F:6.8 is a typical lens. In the Dogmar, F:4.5, the elements are of unequal focal length, a triple convertible or hemisymmetrical type. In the Protar VII, the single lenses have four members and higher corrections. They can be combined to make two focus, F:6.3, VIIa Protars, or three focus lenses of F:7 or F:7.7 speed. Other two focus convertibles are the Collinear II, F:5.4, Collinear III, F:6.8, Amatar IX, F:6.8; Turner-Reich Series III, F:6.8; Hekla, F:6.8; Sylvar, F:6.8, etc.

In three-focus types are Velostigmat, Series II, F:6.3, Turner-Reich II, F:6.8, Stigmatic Series II, F:6, Ross Combinables, F:5.5, to F:6.3; Graf, F:4.5, F:6.3, and F:7.7.

The height of convenience is reached in convertible anastigmat sets. These have one mounting taking the single lenses or pairs as desired. They give great flexibility in operating, as you can use the focal length best adapted to your particular viewpoint. Some times there is no alternative viewpoint, but you can always find a suitable focal length among the possible combinations. Thus sets of Protar VII lenses give six different angles and sizes. With four singles, there are ten possible combinations. Pantar and Ross Combinables sets work similarly. In all cases, the doublets should obviously have the larger diameter single lens in the front.

On some imported sets, the diaphragm diameter is

indicated on a millimetre scale and suitable tables of values are furnished. B. & L. Protar VIIa and Ross Combinables have a rotating ring, which when properly set will give values for each and any focal length.

In convertibles, the ratio of single lens focus to doublets is around 1 to 1½ to 2. Turner-Reich singles are 1¾ and 2⅓ times the focus of the doublet, hence their selection for panoramic work.

In the rapid rectilinears convertibles we have Versar, F:6, Voltas, F:8; Rapid Rectigraphic, F:8, Rapid Convertible, F:8. Perigraphic Convertible, F:5.6, Planatograph, F:8, Euryscope IVa, F:7, Ideal D.F:6, Dallmeyer F:8 and many others, some two focus and others triple convertibles.

The single elements of Protar VIIa and Pantar being highly corrected are very satisfactory at the larger apertures. They are not perfectly rectilinear. With single elements in general you are not concerned with covering power for large areas, as you will ordinarily use them for the same size negatives as the doublets themselves. Their back focus exceeds equivalent focus about 10 per cent when used in the correct optical position, with the diaphragm in front of lens. In practice, you can work them in the front position with very satisfactory results. It has the effect of adding bellows extension. While focus scale divisions are unaffected, the position of scale is nearer the image.

The general conclusion to be drawn from this brief survey of the lens, its errors and their correction, with its properties is that, for all around purposes one should choose (1) a perfectly corrected lens giving a sharply defined image over a flat field at a large aperture, (2) combining maximum rapidity and depth of focus capacity, and (3) capable of covering the plate in use sharply from center to corners, even when the lens is shifted from its normal position at the center of the plate by the use of the rising or cross front movement. This means (1) an anastigmat, (2) of the shortest focal length consistent with reasonable perspectives, (3) with ample covering power for the plate with which it is to be used.

Almost every different field of use, however, calls for specific properties in the lens advantageous in the par-

ticular field of use. In the following pages, therefore, we will consider the requirements of some branches of everyday photography and the available lenses best fitted to meet these special requirements.

Aerial Photography calls for only brief mention as far as lenses are concerned. Thoroughly good work was done in pre-war years, from balloons and kites, with ordinary apparatus equipped with lenses of great focal length compared with the plate sizes used. Examples may be seen in THE PHOTO-MINIATURE: No. 52, published in 1903. During the War airplane work and all branches of aviation photography received a great impetus. Anti-aircraft guns forced photographic observers to high altitudes making necessary long focus lenses, some of them exceeding 40 in. in focal length. Peace work presents different conditions. The work is done chiefly at low altitudes. The obtaining of good images is largely dependent upon the use of filters and sensitive materials to overcome difficulties arising from atmospheric conditions, haze, color contrasts, etc. Special camera construction and devices for compensating the errors introduced by the departure of lens axis from vertical position play an important part in the quality of the result. Since the lens is invariably used at its infinity focus the size of the image is directly proportional to the focal length of the lens, and inversely proportional to the altitude of viewpoint. As against the use of great focal length to obtain large images, it has been found desirable to use shorter focal length, getting smaller images for subsequent enlargement. Thus lenses of 8, 10, and 12 in. focal length, e. g. the Bausch and Lomb Series Ic, IIb, Tessars; Goerz Dogmar; Carl Zeiss Ic, and Cooke Aviar are widely used.

Airplane mapping has a broad field in survey work as an enormous labor saver in supplementing ordinary methods; also in commercial view and bird's-eye work, the photographing of estates, industrial plants, and the like. In some mapping cameras multiple lenses are used and the records are combined. Special devices are employed in photographing with motion picture cameras from airplanes, and in balloon photography fixed-focus telephoto anastigmats have been used with advantage.

Architecture. In this field we are concerned with the representation, on a flat surface, of three-dimensional objects, designed to produce a pre-determined effect when viewed in a chosen location, with straight or curved vertical and horizontal lines or forms as a characteristic feature. Obviously the problem is one best solved by stereoscopic or two-lens photography; but here we are dealing with everyday architectural work, using the ordinary one-lens camera and equipment.

Scale, perspective effects, accurate drawing and detail definition are the prime essentials. In the choice of lenses we must consider focal length, which, from a given viewpoint, controls the scale of the image and perspective effects; freedom from distortion (rectilinearity) as necessary for correct drawing; and view angle capacity with covering power, which have to do with wide-angle work when this is necessary, and limit the field of available definition and even illumination when the lens is shifted from its normal position at the center of the plate, as often happens in this class of work.

Because of the general difficulty of securing the ideal viewpoint, focal length is the vital factor. The common fault is forced or violent perspectives, due to the use of lenses of too short focal length, often necessitated by the restricted working space available.

Equipment. Three lenses of different focal lengths: the first slightly less than, the second one-and-a-half times, and the third two or two-and-a-half times the base or diagonal of the plate, may be regarded as the minimum equipment for the widely varying requirements of the field. Sometimes an "extreme angle" will be necessary, and a telephoto may be useful where the subject includes inaccessible detail, as in public buildings made for architects.

The lens equipment may consist of separate, complete lenses, rectilinears or anastigmats, or better, of the more compact convertibles or sets of the anastigmatic type.

Since short exposures are rarely called for in architectural work, except in difficult interiors and exteriors with nearby trees in foliage, and as all lenses must be stopped down for depth, good work can be done in this field with rectilinear lenses by reputable makers, which

can often be picked up for a song. They are slow and limited in covering power, but extremely efficient if handled intelligently.

The more perfectly corrected anastigmat, with its excess covering power and greater angular capacity (permitting its use as a wide-angle on a large plate when stopped down) is, of course, the better investment, e. g. the Turner-Reich F:6.8; Tessar F:6.3; Serrac F:4.5; Velostigmat Series IV; Dagor F:6.8; Cooke F:5.6; Graf F:6.3 and Collinear F:7.7.

Especially advantageous because of the variety of focal lengths available in one instrument, are the convertibles, viz. Stigmatic F:6; Turner-Reich Series II; Velostigmat F:6.3; Graf F:6.3; and the Protar and Pantar sets, in which the single elements are corrected for distortion and astigmatism.

For special wide-angle work the Protar F:9; Turner-Reich F:18; Velostigmat F:12.5; and Primoplane F·6.5 are largely used. The Dagor F:6.8 also offers usefulness here because of its fine correction over an unusually extended field. For tall buildings or skyscrapers in confined situations, the Hypergon (maximum angle, without star diaphragm 110°) is the only lens available.

The telephoto needed for occasional work may be either a negative attachment fitted to the regular positive lens of short focal length, such as the Bausch & Lomb, Goerz, Carl Zeiss or Voigtlander telephoto attachments; or a complete lens of the variable or fixed-focus type, e. g. the Pancratic; Adon; Dallon; Magnar or Cooke Telephoto.

The fact that the camera and tripod largely influence the performance of the lens in architectural photography should not be overlooked. It is folly to invest in high-priced, highly-corrected lenses having special properties, and to lose in the results by the use of poor camera equipment. Lack of accurate adjustment, perfect rigidity and steadiness and any liability of vibration are fatal to success in this sort of work.

Color Photography. In the use of screen plate methods, the correction of the lens for red (apochromatism) is not as important as in color-separation or registration processes. The red records are always best when the

red focus approaches the general focal plane and exposures are thus reduced. Speed is always an advantage, because of the loss of light incidental to the use of compensating filters, hence the advantage of lenses working at F:4.5. Flashlight color work demands special filters because of the differences in the actinic values of flashlight and daylight.

In screen plate work, when the filter is used at the back of the lens, this compensates for the reversal of the color plate in the holder and saves reversal of the ground-glass screen for focusing. Zeiss Ducar filters are designed to work in front of the lens and compensate focus displacement optically, as does the Graflex color plate holder. Around sunset the atmosphere acts as a filter; all the violet is gone at 8° sun elevation, but 55 per cent of the red still remains.

In color reproduction processes (separation work) the best results are obtained with apochromatic lenses, e. g. Goerz Artar; Zeiss Apochromatic Tessars; Collinear F:9; Cooke Series V and Va; Velostigmat Process Lens and Dallmeyer Series VIII, all less rapid than anastigmats not corrected for three-color work.

Commercial Work. Lens economy and lens efficiency, with a minimum of weight and bulk for carrying, point to the anastigmat sets Protar and Pantar as ideal for the infinitely varied requirements in this field. Next in usefulness come the convertible anastigmats, e. g. Protar VIIa, F:6.3—F:7.7; Dagor F:6.8; Turner-Reich Series II and III; Stigmatic F:6; Wollensak Series I; Graf F:6.3 and Collinear III, F:6.8. These provide appropriate focal lengths for any condition and rendering desired, except perhaps extreme wide-angle work, for which a special lens should be provided. The single combinations will rarely be used at full covering power, give brilliant images, and are very satisfactory in practice.

Where rapidity is not essential, rectilinears give very good results with ample focal lengths and small apertures. Cooke F:8 and Turner-Reich F:9 are good and moderate in price because of lower speed.

There are cases where perspective depth and size cannot be obtained simultaneously, as with large images

of cut glass and deep silver bowls. In such cases, make a small negative getting the desired depth at proper perspective distance and from this make a large print by projection. This is better than seeking for the ideal long-focus depth-producing lens which does not exist.

For work requiring the inclusion of a large view angle a medium or extreme wide-angle lens must be used. For a choice of these see *Architecture*.

Copying. The best copies come with process lenses when there are fine lines to reproduce, but the rectilinear finds many applications. It should not be too short in focus nor worked to extreme covering power. Stopping down does not cure astigmatism and, for ability to pick up shadows, the anastigmat stands alone. The moderate speed types are used. For lenses primarily for copying, you can select F:8 or F:9 lenses used in commercial and photoengraving work, e. g. Gotar, F:8, Dallmeyer Process, Series IX, also longer focus wide angles like Protar V.

Too short a focus makes it harder to overcome reflections on glossy prints and paintings. With large originals, a long focus lens allows good working distance and does not force side lightings, which emphasize surface texture.

With artificial lighting in general, you should illuminate copies from both sides equally to get rid of surface grain. Glycerine on a print covered with glass has been used effectively. Color sensitive plates speed up copies with tungsten lamps which are rich in red rays. The use of filters for ortho effects is a chapter by itself and astonishing results may be obtained by proper technique.

Smaller stops tend to give flatter results and the best plan is to use the largest stop consistent with definition, especially on line subjects, which are usually best on slow plates. Focus critically and save stopping down. Large lenses stopped down give more equal illumination, because they intercept fewer marginal rays. Fine ground glass and focusing magnifiers are useful accessories. Accurate register of plate holders is quite necessary.

For full size copies, you can often use shorter focus lenses because you have really doubled the focus and covering power. The exposures vary with distance as noted under *conjugate focus*. You will learn to judge

illumination on focusing screen although tables of stop changes and exposure figures can be obtained. Artificial lights are more constant in value than daylight and are very convenient. Chemical focus troubles from lights varying widely from daylight are mentioned under enlarging.

Paintings should not be inverted, as artists get shadow effects from brush marks, and these may change effect in the photograph because direction of lighting is changed.

View cameras or cameras with double extension, are convenient for coyping, and the simple portrait types for post card and penny picture work can be obtained very reasonably.

Enlarging. Lens selection depends on size of negative and available working distance. Enlargement size is governed by distances between lens, negative and paper. Your problem is to transfer a flat negative image to a flat easel. The less you stop down, the less exposure you need, an advantage on dense negatives. Moreover, long exposures are liable to suffer from vibration and irradiation, which is a species of halation or sidewise spreading of the image in the sensitive film.

Flat field anastigmats have advantages because you can work shorter focal lengths and reduce image distance. Moderate speed types are best as any of F:6.3 types mentioned for hand cameras, also the F:8 and F:9 lenses for commercial work. In using artificial light metal diaphragm leaves are sometimes necessary because of heat. You can often find rectilinears that serve very well of somewhat longer focus. Portrait types vignette on corners, but with large negatives they have some advantages.

The lens with which the original negative was made is often recommended. If its error is a drop in illumination at edges of field, such errors may be increased. Even with an ideal enlarging lens you cannot increase the negative quality. You may stop down, but you still have an optical record of the negative defects. Lenses can be specially corrected for enlarging, e. g. the lenses fitted to Kodak Projection Printers, and are valuable where there are many dense negatives. Such lenses do not need as much stopping down.

Definition can be softened by black chiffon cover over the lens or by various grades of bolting cloth near easel, or by soft focus lenses on sharp negatives. With old type Veritos, diffusing stops with radial openings gave diffusion control. The current Verito lenses do not require them. The finest effects, however, come from soft-focus negatives. In enlarging from sharp negatives it is better to work from positives, because the enveloping image from the soft-focus lens is then formed round the high lights as it should be. Diffusion on the Eastman Projection Printer is obtained by the Diffusing Disks with minute optically-worked corrugations, giving various degrees of softness.

Non-symmetrical lens types have a larger front glass diameter and are corrected for use with large lens facing object. In enlarging, the negative is really the object being photographed. Unqualified statements about reversing lenses are confusing, for when you put a lens on the ordinary enlarging apparatus in the natural way, it is facing correctly and a further reversal makes it wrong. When copying, enlarging and reducing cameras are used for direct enlargements, the kind where the lens goes in a central compartment, you have a choice and the lens boards are so devised tnat lens may face either way. You can always go straight on any type of apparatus by noting the longer distance, lens to subject in copying and lens to paper in enlarging, and then use the lens so that its larger glass or the cap end of the lens lies on the same side of the front board as the greater distance. In modern enlarging cameras, the bellows encloses the lens to object distance, just the reverse of ordinary conditions.

Condensers. Much enlarging is done with condensers or reflecting substitutes. The lenses are plano-convex, short in focus, with convex surfaces nearly touching. They collect light from the enlarging lamp and converge a cone of rays to fill the back glass of projecting lens. If the cone is too big or too small some light is wasted. The negative sets in the cone of light, near flat side of front condenser.

If the light is not properly adjusted, you get uneven illumination and shadows, which indicate the re-adjust-

ment to make in light position. The cone should be central on the axis of the lens and while in theory it should meet at diaphragm, it has to be focused further front, due to lens aberrations. The nearer the light source approaches a point, the less trouble from unequal illumination and shadows, when lenses are stopped down. Conditions are somewhat different, however, with very large sources, like flaming arcs, or with inverted Welsbach mantles. It may be impossible to get a clear field on edges even when the light is centered, this indicating that lens focus does not suit condenser focus or vice versa, or that the lens has too small diameter. The best focal length is about 10 per cent greater than long side of plate. Such lenses work well with the condensers listed for sizes corresponding to sizes for which lenses themselves are listed. A 5 x 7 negative needs a 9-in. condenser, which works nicely with 7 or 8-in. 5 x 7 lenses on ordinary ratios of enlargement. For only slight enlargement or for reductions as in lantern slide making, a different focus lens or condenser may be required. In taking small heads from groups, a short focus lens of low quality may be used because of small angle required.

With 14-in. condensers, there is always trouble in getting a field without colored margins. Even 12 or 14-in. F:6.3 lenses may be too small. A large diameter lens, e. g. portrait or projection types, is needed. Such large lenses act as auxiliary condensers and change the angle of the cone of light. Restriction of lamp movement is a common error in apparatus. You need convenient adjustments up and down and crosswise and ample space for movement to and fro.

Condensers always have ripple marks or striae which may show up as shadows on the screen. Condensers should not be heated up too quickly and they are easily scratched. The striae show when you dispense with diffusers between condensers to gain speed. The diffusers can be used near the light to better advantage. The diffusion idea has been adapted in a more elegant way by frosting tungsten bulbs. Not only do diffusers at the light give more even illumination, but they avoid harshness in results and lessen the need of light distance adjustments.

Condenser Substitutes. There are very convenient parabolic mirror substitutes for condensers, for use with high power incandescent lamps. These work in connection with other cameras, or as part of a complete apparatus. With enclosed arc lamps enamel lined, hollow, rectangular pyramids called "cones" reflect light on negative through diffusers. In larger sizes, they work slower because light spreads over a larger area. The cone may be dispensed with when the powerful and convenient "M" shape Cooper Hewitt lamps are used. Simple devices of parabolic shapes like Brownie illuminators, work with fixed-focus enlargers or for lantern slides from small negatives. With the intense light from white carbons, much work is now done with flaming arcs.

Color Problems. When the enlarging light differs greatly in spectrum composition from daylight, your lens may show chemical focus. In some of the modern lights, especially the enclosed arcs, powerfully actinic rays are given out by the arc vapor shell. When the enlarging papers used are supersensitive to these particular rays, the shift of focus is intensified. The optical glass is relatively opaque to ultraviolet as is well known, and the effects must be charged to excess of violet. The thicker the condenser, the more filter action on these false rays. Rectilinears of the old types are curiously less prone to false images. There is more shift on the lesser ratios of enlargement and compensation by trial and error methods may be necessary.

Other optical troubles may come from the lens being out of center with negative; lens axis out of perpendicular with negative or easel or both; negative loose in carrier; movement of parts of apparatus during exposure; buckling of the paper; dust and moisture or greasy fingermarks on the lens. If you can arrange the negative carrier so that the emulsion of the plate side rests on the rabbet of the holder and negative goes in from the back, negatives of different thickness will register. You can use a ruled plate to test focus. This is useful on dense negatives and where prints are required of one scale of enlargement. Turning on the light constantly to find the cap or to set the diaphragm is a nuisance and outside of

this, destroys your ability to judge the illumination of the image which is best when eye is dark-adapted. This condition is not restored for some moments. Do not attempt to focus through the orange safety cap.

Engineering and Construction Work. The lens problems in this field are similar to those in architecture and landscape. With field cameras, offering bellows capacity and tripod convenience, a set of convertible lenses offers flexibility in focal length. Compact hand cameras are much used for recording progress of work from day to day. These give facility in getting detail and in working from viewpoints where the use of larger cameras is not permissible, enlargements being made from selected negatives. Anastigmat equipments are almost indispensable, speed, definition and angular capacity being lens essentials in this sort of work.

Flashlight. In general flashlight and interior work, the difficulty in focusing demands a large aperture lens of the anastigmat type. It will, of course, be stopped down for depth before the exposure is made. Interior and dinner parties are often made with "banquet" cameras for plates 12 x 20 and 7 x 17 inches, which call for lenses of very large available angle for the respective diagonals of 28.3 and 18.4. For the larger size the Dagor 14-in.; Tessar or Carl Zeiss IIb, 16-in. and Turner-Reich II, 15-in. will cover satisfactorily. For the smaller size the Tessar or Carl Zeiss IIb, 10-in.; Dagor 10¾-in. or Turner-Reich 12-in. may be used. Wide Angle lenses are also used, for which see Architecture. On these banquet cameras, a swing-front is substituted for the usual swing-back movement, because of the greater need of tipping the camera downward. The advantage of an anastigmat here is found in the flat field characteristic of this type. You do not have to stop down to any smaller aperture than is requisite to give the desired depth, which often means a larger aperture and shorter exposure. Quantity of powder with a minimum of smoke nuisance result when open flashes are used.

For flashlight portraiture in the studio, with such devices as the Victor Flash Cabinet, the ordinary portrait lens will suffice for all classes of subjects. In home portrait work the lenses fitted to special home outfits or

the amateur's hand camera will generally meet the requirements, the anastigmat being ideal.

Flowers. Proper perspective effects and proportion of parts are essential in this work. Focal length is therefore a prime consideration, although rapidity is also a desirable aid as flowers wilt quickly in the studio and are subject to continual movement when photographed out of doors. With short focus lenses the near parts appear much too big and more distant parts are dwarfed. Convertible lenses are most useful, the single elements offering a wide choice of focal lengths for different requirements. The camera, of course, must have ample bellows extension to accommodate the changing focal lengths used. With some flowers which present a deep cup-like formation with interior details, the device of getting a small image with a short focus anastigmat stopped down for depth and then enlarging from this negative, is necessary to properly represent the subject. With hand cameras out-of-doors, the portrait attachment or a fixed-focus telephoto of large aperture will give large images with limited camera extension. In some cases, as in making catalogue illustrations for seedsmen, where it is desired to show one part or element of a flower or bloom more prominently than the remainder of the flower, wide-angle or medium-angle lenses are deliberately used to get this disproportionate rendering of part of the flower.

Hand Cameras. Rectilinear lenses of excellent quality come on ordinary equipments. Moderate price anastigmats have become popular of late years, to meet the demand for better corner definition than the old rectilinear can give at its full aperture. Such types are the Kodak Anastigmat, F:7.7, Wollensak, Ansco Modico, Rexo and others of F:7.5 speed. Moderate speed anastigmats of F:6.3 type are the practical limits of speed, because of focus scale errors due to the limited depth of the faster types. Above F:6.3, the percentage of unsharp pictures from misjudging distance is very high. This can be overcome by using a Kodak Range Finder or Heyde Distance Meter. Faster lenses have their proper place on cameras where speed can be used efficiently, like reflecting types or on miniature cameras taking shorter

focus lenses. The F:6.3 lenses figure 60 per cent more speed than rectilinears and 44 per cent above F:7.5; but when equal definition is considered, they show about double the speed of the rectilinear in practice.

The 3a sizes take lenses 6 to 7-in. focus, $2\frac{7}{8}$ x $4\frac{7}{8}$ and $3\frac{1}{4}$ x $4\frac{1}{4}$ need 4 to 5-in. focus in appropiate shutters with exposures in some cases running up to 1/300 second. Kodaks and Premos come with Kodak Anastigmats, F:6.3 and F:7.7, Tessar 11B, F:6.3, Protar VII F:7 and B. & L. Kodak Anastigmat, F:6.3; Ansco furnishes Ansco Anastigmats, F:6.3; Modico, F:7.5; Ica and Contessa cameras carry Carl Zeiss Ic, F:4.5; IIb, F:6.3; Dominar, F:4.5; Amatar IX, F:6.8; Hekla, F:6.8; Citonar, F:6.3; Teronar, F:5.4; Goerz cameras are fitted with Dogmar, F:4.5; Dagor, F:6.8; Tenastigmat, F:6.3; Rexo cameras have Rexo and Cooke Anastigmats, F:4.5, F:6.3, and F:7.5; Ernemann cameras are equipped with Carl Zeiss, Ernon, Ernar and Vilar anastigmats. Special lenses may, of course, be fitted to order. Hand camera lenses are often mounted more compactly for the smaller shutters used. Others come in cells threaded to go direct into standard shutters. There is no objection to using a convertible doublet when available but lack of bellows capacity usually bars out the use of single combinations.

Speed cameras of the focal plane type, without reflecting mirrors, e. g. Speed Graphics, the Palmos B, Deckrullo-Nettel and others have ample lens board room. You can fit F:4.5 lenses as on reflecting cameras. Where the camera front comes out on struts, to a fixed extension, you need special focusing mounts for lenses. Such cameras are Goerz Ango, Ica Palmos, Contessa-Nettel.

Cameras of the compact cycle types with focusing screens, like Cycle Graphic, Premo, and Ingento, have lens boards which will take large diameter F:4.5 or "soft focus" lenses. Convertibles and some telephoto lenses are practical because of the ample bellows provided by this type.

Some of the Ica, Goerz and Contessa cameras have double bellows extension in the small sizes and with choice of convertibles. Nostar and Distar used with Zeiss lenses give telephoto enlargement.

Interiors. Photography indoors is often hampered by lack of space. You cannot get back far enough to include all you wish to show, and wide-angle lenses are quite necessary. You must accept their limitations and make the best of the situation. To cope with inevitably strained perspective, experienced workers will remove objects right up under the lens and arrange others so as to break up unpleasant lines. The ground glass is the only sure test, as objects visible to the eye are often obscured to the camera. You can modify bad lines by not having the camera too high. A high position makes the floor seem to run up hill. Central viewpoints are rarely satisfactory. Swing and rising or cross front adjustments are constantly used. Tilting tripod tops are very convenient, also a ground-glass ruled in squares to check up vertical lines.

Regular wide-angles are slow. With a convertible doublet, of short focus, e. g. Dallmeyer Stigmatic, F:6, you have more light in focusing, also with rapid wide-angle types like Bausch & Lomb, Series IV and V; Primoplane, F:6.5; Protar IIIa, F:9; Wollensak III, F:9.5. The less expensive wide-angles, as Turner-Reich, Series X and Symmetrical, F:16 have advantages on certain subjects: looking down a street or into corners of rooms, where the field of lens fits field of view.

The Hypergon has special applications when its enormous angle of 135° can be utilized. With this lens or any lens over 90° angle, it is quite possible from a corner viewpoint to show all four walls of a room.

Landscapes. The problems of perspective and angle of view lead at once to convertible lens selections, e. g. Turner-Reich, F:6.8; Dallmeyer Stigmatic, F:6. Lenses you can build up into sets, like Protars and Pantars, have advantages when a limit in viewpoint is forced upon you.

Old single landscape lenses make brilliant images, and soft focus lenses find application in your pictorial work. Rectilinear lenses are used by thousands, both complete and in the single combinations, e. g. Gundlach Perigraphic and Rapid Rectigraphic.

In mountain landscapes particularly do you need long focus lenses. Contrast is hard to preserve and filters are indispensable. Telephotos find useful application where

large images or distant detail is desired, e. g. Bausch & Lomb Telephoto Attachment; Gundlach Pancratic; Dallmeyer Adon, Dallon, etc.

Marines and Surf Photography. On the water or at the seashore the abundant illumination makes the choice of a lens a simple matter as single landscape lenses, rectilinears or anastigmats may be used at will. Distance plays an important part, so that long focus lenses are most often desirable, fixed-focus telephoto anastigmats and the single elements of convertibles being useful. The principle of taking it small and enlarging afterwards has special application. Mortimer's remarkable surf pictures were made with a rectilinear on $3\frac{1}{4} \times 4\frac{1}{4}$ plates and afterwards enlarged to 20 x 30 inches. Focal lengths double the longest way of the plate give desirable proportion of parts. For nearby surf or breaking waves an anastigmat may be necessary for speed when the light is not of the best. For still work, as in harbors, filters are needed and soft-focus lenses offer pictorial advantages.

Lantern Slides. When correctly made, lantern slides by reduction have advantages in quality over the contact method. The lack of perfect contact affects sharpness. When you make slides by the camera method, the depth of focus of the projected image takes care of any irregularities of surface, and you have added facility of using any or all of the negative, and enlarging or reducing the scale.

A flat field lens saves stopping down. Slides of precise definition allow larger screen images, but no lens can hold definition not present in the original negative. The focus may be as short as 4 or 5 inches, as you figure only on covering the maximum mask opening of $2\frac{3}{4} \times 3$ in.

Miniature Cameras. Anastigmats of short focal length are usually fitted to small cameras. While relative aperture is preserved, the actual diameter of the lens becomes small enough to permit fitting to compact interlens shutters. You approach conditions of universal focus, with comparatively large stops. Quite often the light conditions permit stopping down and still further improvement of definition. The enlarging possibilities then increase tremendously. Objects in different planes are now more equally sharp, and as the image shows

less contrast in sharpness, it permits a greater degree of enlargement. Larger pictures will naturally be viewed from greater distances, which again helps the situation. Motion pictures are often quoted in explanation, but the analogy is complicated by the rapid shift of images and the persistence of vision effects. Very large enlargements from motion picture films have been made to 40 x 54 inches with excellent effect. The images at close range show individual silver grains, but at suitable distances become pictures in continuous tones, suitable for large exhibition purposes. All lenses of sufficiently short focal length are fitted to miniature cameras, with maximum efficiency in anastigmats of speeds F:4.5, F:6.3. See *Hand Cameras*.

Nature Photography. Speed is the primary essential in this field, together with the large images given by long focus lenses. Frequently the work must be done under poor light conditions or from distant viewpoints, with shy and restless subjects. In some instances the camera is concealed in a "blind" where a "close-up" of the subject is desired. Such conditions call for anastigmats of large aperture and rapid fixed-focus telephotos.

Carl Akeley, in photographing African big game, made good use of the single element of a convertible anastigmat, which gave him a focal length of 24-in. sufficient for a fairly large image from distant points. The fixed-focus telephotos now available are invaluable in this sort of work. Thus the Dallon F:6.5, with a camera extension of 6 inches, gives an equivalent focal length of 15 inches, i. e. a magnification of 2½ times of the image given by the normal 6-in. lens. The Naturalists' Graflex is fitted with the B. & L. Telestigmat of 14½ inches focal length, giving an image the same size as would be obtained with a 24-in. lens.

A 17-in. lens, working on a reflecting camera which ordinarily uses an 8-in. lens, will give an image one inch high of a deer thirty-six inches high photographed at 50 feet, or 2¼ inches high if photographed at 25 feet.

Panoramic Work. For matched section panoramic views the lens should be of ample focal length, and for very accurate work the rotation point is not at the tripod socket, but under the back nodal point of the lens.

If the camera has a supplementary bed, you can adjust it to satisfy this condition, or such a bed can be improvised. Liberal overlaps are advisable because of the chance of defects at the edges of the negatives and also to allow for a true joint between the sections. The camera must be carefully levelled, so that the horizon runs true through all sections. Cirkut cameras need convertibles, the long focus single lenses being very useful. While film and camera both move, the image laid on by the slot is relatively at rest and stays sharp. Cirkut lens fittings must be made by the makers of the camera as the proper gears are determined by trial and error.

The angle of rotation determines the angle of view; you really make wide-angle views with a long focus lens. The longer the focus, the better the proportion of any figures in the group, and the distortion of long architectural lines is reduced to a minimum. Expert Cirkut operators take positions opposite one end of a building and thus avoid perspective lines running both ways. Any convertible lens is suited to this camera, but the spacing of focal lengths on the Turner-Reich Series II makes this an ideal lens for the purpose.

Panoramas 6 x 20, 7 x 17 and 5 x 12 can be made with cameras of the "banquet" type or the Gundlach Panoramic, the lens requirements being as given under *flashlight* work. The bellows capacity of these outfits is sufficient to accommodate the single combinations of some convertibles.

Photo-Micrography. Low power photo-micrography is simply direct enlargement with short focus lenses. Thus for objects requiring a magnification of 2 or 3 times only, a lens of 3-in. focal length is used, while for magnifications of 7 or 8 diameters a rectilinear lens of about 1¾ in. will serve.

Specially corrected lenses such as the Micro Tessars, with front and back cells that interchange give, with a bellows draw of 20 inches, enlargements of 15, 10 and 7 times for 32, 48 and 72 mm. foci. Spencer photographic lenses are furnished in 16, 32 and 48 mm. foci and Zeiss Apo-Planars from 20 to 100 mm.

Results in high power work depend largely on the

painstaking centration of lighting and optical systems and super-rigidity of apparatus. Motion picture lenses of short focus are sometimes used because of their focusing devices e. g. the Kino Hypar, F:3.5. Elaborate photo-micro equipments are furnished by Bausch & Lomb, and Folmer & Schwing furnish apparatus designed for low power and laboratory work. Micro-photography is the reverse process, the making of very small images from large originals, such as microscopic scales for apparatus of various sorts and the pictures in the tiny opera glasses and novelties imported from abroad. In this method there is need for the same super-accurate corrections and adjustment, wide-angle lenses of short focus (1-in.) being used.

Portraiture in the Studio. Three factors control the selection of lenses for studio portraiture: focal length, rapidity and quality of definition.

Truth of drawing—the avoidance of distortion or disproportion in the features and parts of the figure, together with the ability to control the size of the image on the plate (scale), depend on the focal length of the lens used. Wherever possible, a lens of focal length twice the longest side of the plate should be used for figure portraits, with greater focal length for large heads and shorter focal length for groups. Unnatural perspectives result from yielding to the temptation of too large images with lenses of short focal length. Moderate size images, made at a proper distance with a fairly long focal length, will give more pleasing portraits and cut down the demand for resittings. The available operating distance, i. e. the length of the studio, will determine the maximum focal length which can be used. As to this point the reader is referred to the tables showing the minimum length of studio required for lenses of different focal length, which may be found in the yearbooks and some pre-war lens catalogues.

Rapidity is essential in the portrait lens to avoid the possibility of movement in the subject during the exposure, especially with children and restless sitters, and also because of the limited volume of illumination used in many studios. This has been estimated as not more than 1/500th of the bright light out of doors. The

general use of powerful artificial lights in modern studios, together with the super-speed films and plates of today, may have remedied this difficulty in some measure, but a speedy lens is still a desirable studio feature.

Speed and "Depth" do not go together in lenses of large aperture over three inches focal length, but most portrait lenses working at F:4.5 give sufficient depth when handled judiciously. Fast lenses which have to be stopped down for depth are no longer fast. Roundness and relief effects are thus often sacrificed, this resulting from the loss of the large aperture peculiar to the portrait lens. As matter of fact by "depth" the portraitist means, not the "depth of focus" so much discussed by outdoor workers, but a roundness, relief and atmospheric depth which enable one to look into the picture as it were. This pseudo-relief in portraiture is the result of skillful lighting or the illumination of the subject and the use of a lens of large diameter.

The Quality of Definition desired in a portrait today is a matter about which no two professional workers can agree. Formerly it was thought essential to secure the finest possible definition in the center of the field, usually occupied by the head of the subject on the plate. In accordance with this belief the standard portrait lens, originated by Petzval, in 1840, was designed to give a brilliantly illuminated and microscopically defined image within a limited area (usually not larger than the diameter of the lens itself) at the center of the plate, and to do this with a large aperture, meaning rapidity. With portrait lenses of this type there is some curvature of field, astigmatism, distortion and a tendency to flare when small stops are employed.

Portrait Lenses of the Petzval type, improved in various features, can be obtained today from many lens makers, e. g. the Vitax F:3.8; Vesta F:5; Eastman Portrait Lenses F:4 and F:5; and Gundlach Series A. The Dallmeyer Patent Portrait Lenses, in three series, F:3, F:4 and F:6 are constructed on a different principle, and are free from many of the faults of the Petzval type.

The introduction of the modern anastigmat led many makers to design these in the larger sizes to replace the earlier types of portrait lenses, e. g. the Tessar or

Carl Zeiss Ic; Cooke F:4.5; Graf F:4.5; Heliar F:4.5; Beck Isostigmar F:5.6; Portrait Hypar F:3.5 and F.4.5, and the Aldis F:3. These are anastigmat portrait lenses and, in addition to their rapidity and critical definition, offer the advantages of flatness of field and large angular capacity, properties which are very useful in photographing full length figures and groups. where the older portrait lenses have to be stopped down.

The modern tendency in favor of diffused or soft definition in portraiture has resulted in radical changes in studio lenses. Thus the Dallmeyer Patent Portrait Lenses, the Cooke Portrait Anastigmat, the Graf Variable, the Beck Isostigmar, the Aldis and the Velostigmat mentioned above are all fitted with diffusing devices attachments giving any degree of softness of definition at will, with critical sharpness when this is desirable. Among portrait lenses specially designed to give soft-focus effects may be mentioned the Smith Visual Quality F:4.5; Verito F:4; Plastigmat F:5.6; Bishop S.F. F:6; Hyperion F:4; the Struss Pictorial F:5.5 and the first of all soft-focus lenses, viz. the Dallmeyer-Bergheim.

Large Heads should be made with a very long focus lens. Such lenses are necessarily bulky and demand ample studio length. If the available operating distance does not permit this being done direct, it is better to get it by enlargement from a small negative than to attempt to do it direct on a large plate with a short focus lens. The front element of an old lens of the Petzval type will serve this purpose very well. Remove the rear element and the hood from the front cell; put the front element in the rear cell and replace the hood in the front lens cell threads. This will double the focal length and give a very pleasing, soft definition.

Groups and Figures call for flat field lenses of large angular capacity, with speed. This means an anastigmat. Rapidity means the elimination of movement; a flat field gives better proportion of relative size among individuals in a group, and covering power means better definition and illumination out towards the edges of the plate. Long focal length is always desirable where the length of studio permits. Groups made with lenses of

short focal length and wide angle have unpleasant perspectives—the penalty paid for lack of operating distance. Most of the lenses mentioned as anastigmat portrait lenses above are admirable for group work. For 8 x 10 and 11 x 14 plates the focal lengths generally used are 12 and 14 or 16 inches respectively. Other good group lenses are the Dagor F:6.8; Syntor F:6.8; Pentac F:2.9; Tessar IIb F:6.3; Graf F:6.3; Turner-Reich F:6.8; Cooke III F:6.5 and Collinear F:6.8. Of course the convertibles, Protar, Pantar, Turner-Reich and Stigmatic will be used by those who possess them.

Home Portraiture. Much of what has been said about lenses for studio work applies to portraiture in the home. But here we have to take conditions as we find them, e. g. poor lighting conditions, lack of operating distance, etc. Speed is the most necessary lens quality and 12 inches will generally mark the limit in focal length. When hand or reflex cameras are used the lenses must, of necessity, be compact and this bars out the bulky portrait lens of large diameter and generous focal length. Any anastigmat of F:6.8 or thereabouts will cover most requirements; the convertibles or sets afford variety in focal lengths useful in many cases; and the fixed-focus telephoto anastigmats, e. g. the Dallon Series XVIII F:6.5; Series XVII F:6.8; Series VI F:5.6; and Cooke Telephoto offer the advantages of long focal length (large images) with the normal camera extension. When large aperture anastigmats are used in portraiture, at home or in the studio, the use of a lens hood will vastly improve the quality of the results.

Scientific Uses. The laboratory tasks run to copying, enlarging, lantern slide making, etc. A good convertible or set is the best selection. It may be used on copying, enlarging, and reducing cameras and the special laboratory outfits or lantern slide cameras, or on the view models and compact double extension cameras intended for use both inside and outdoors. The doublets do the copying. You find the single lenses useful for flowers, minerals, etc. Short focus movie lenses or photo-micro lenses are useful for direct enlarging of very small specimens. Some of the special photomicrographic outfits are

also admirably adapted to certain types of laboratory work.

Photography has innumerable applications in special photo recording devices such as electrocardigraphs, motion time study, meterological recording instruments, oscillographs, and many others. In spectrum research for transparency to ultra-violet, the optical system must be made of quartz. Astronomical work is done with large diameter lenses of the Petzval type or special anastigmats, such as Cooke Series V and Astro-Tessars. All such lenses are permanently focused by trial and error methods. Ordinary telescope lenses with filters have been successfully employed for some purposes.

Soft-Focus Lenses are so fully dealt with in The Photo-Miniature: No. 184 that we need not consider them here. See under *Portraiture*.

Stereoscopic Photography calls for no special lens requirements except that the two lenses employed should be matched in focal length and the shutter units must give identical exposures. The separation of the lens centers in American stereo practice is generally fixed at 3 1/4 inches in larger sizes and less in smaller sizes. European stereo outfits use a smaller separation, around 2 1/2 inches. Stereo distortion results from too great lens separation. In scientific work the camera itself can be moved, giving absolute control of the angular separation on close-up positions.

Supplementaries. These are extra or auxiliary low-power lenses which, added immediately in front of the regular lens on the camera, serve to alter its focal length to meet special requirements. Thus the addition of a thin positive (convex) auxiliary shortens, while a negative (concave) auxiliary lengthens the focal length of the lens with which it is used. They were first introduced for use with fixed-focus hand cameras, as an inexpensive device enabling the user to obtain pictures of objects nearer the camera than was possible before with cameras of that type. Today they are available for use with both fixed-focus and focuing cameras, for making sharply-focused (large) images of nearby objects or "close-ups" of any description, e. g. the familiar Kodak Portrait Attachment, and are sometimes sold in sets for amateur

copying, "wide-angle" work and the like, with cameras having limited bellows extension.

This does not mean, however, that supplementaries are in any sense equivalent to the highly corrected single elements of lenses of the convertible type, or that they can be used in the same way. While so constructed that they do not materially interfere with the normal qualities of the lenses with which they are used, they cannot be expected to equal the performance of the regular, corrected lens. Generally there is a softening or diffusion of definition, with a lowering of efficiency, hardly noticeable or detrimental in the kinds of work for which supplementaries are employed.

In practice the maximum efficiency is secured with auxiliaries designed and adjusted for use with specified lens equipments. But ordinary uncorrected spectacle lenses can and have been adapted as auxiliaries, especially in pictorial or "soft-focus" work. A noteworthy achievement in this field is the Wolfe Artistic Lens, a very thin auxiliary lens of zero focus (no power), in the manufacture of which a special variety of glass and carefully computed curves are employed. In use it is simply slipped on in front of the anastigmat or rectilinear with which the camera is equipped, and gives, without alteration of focal length or size of image, the most desirable "soft-focus" effects.

A Novel Use of the Portrait Attachment, as a means of *increasing* instead of reducing the focal length of a lens, was described by Kendrick Chamberlain in *American Photography* a few years ago, and is worth noting by readers interested in home portraiture. I abbreviate Mr. Chamberlain's description. Using a 5 x 7 camera fitted with a symmetrical R. R. lens of 8 inches focal length in home portraiture, the familiar trouble of distorted or violent perspectives was encountered, due to the use of a lens of such short focal length and working too close to the subject. Having ample camera extension, he attempted to remedy the difficulty by using one of the halves of the complete symmetrical, as a separate lens of about 17 inches focal length. This however, was generally impracticable, the room of ordinary dimensions rarely permitting of the necessarily increased distance

between camera and subject required by a lens of this focal length. Removing the rear element of the symmetrical, he slipped a Portrait Attachment of suitable size over the front of his lens, and thereby shortened its focal length to 11 inches. This combination proved wholly successful. The gain in focal length, as compared with that of the complete symmetrical, although falling well within the "operating distance" of the average room, was sufficient to eliminate the violent perspectives before inevitable, and allowed greater freedom in the pose or arrangement of the subject. Incidentally, the addition of the attachment automatically softened or suppressed the somewhat wiry detail given by the symmetrical, thus enhancing the pictorial quality of the work.

Telephotography. The bellows extension necessary for long focus lenses goes beyond practical limits on larger sizes. In the telephoto, like a field glass, you have a positive objective with a concave negative lens, set at so-called telescopic condition. A real image is formed on the ground glass in size equivalent to that of a long focus lens, but with a much shorter back focus or camera extension. Telephoto enlargement has some advantage over ordinary methods in which the granularity of negative image is magnified proportional to enlargement ratio.

Such devices, known as telephoto attachments, are mounted in a tube with adjustable separation and a scale of magnifications on the tube. Together with the regular lens used, they form a telephoto system. The regular lens and the attachment lens are for brevity called telepositive and telenegative. The actual magnification obtained depends on relation of their focal lengths and separation. The angle covered being constant, the low power images do not fill the area covered by positive lens. On high powers, they surpass the positive lens. Full covering power is reached at three or four powers, unless low power telenegatives are used. Magnification times focus of the positive gives the equivalent focus of system, and magnification times the stop number gives the telephoto stop value. Exposures can be figured by telephoto system stop values, but it is customary to note the exposure for the positive lens under ordinary condi-

tions and multiply this by the square of the magnification. A lens of F:6.8, 7 inch focus, at 3 magnifications becomes 21 inch, F:20.4. At 8 times, it is a 56 inch, F:54.4. At 5 powers, with a landscape ordinarily taking 1/5th second, F:32, you would open up to F:8 to gain speed, giving 1/20th, and multiply by 5 x 5, an exposure of 1¼ seconds. You must of course allow for the filter used, and your original exposure must be figured on the part of the landscape which is shown in the magnified image, otherwise you may join the criticism of the rule by skeptics who apply it wrongly. In tele-exposures, you are not concerned with deep shadows of foregrounds which are not included.

In focusing, you set the lens to the magnification required and get fine adjustment by slight change in separation. Moderate speed highly corrected lenses like the Dagor or Protar VIIa are preferable to ultraspeed lenses for the telepositives. Bausch & Lomb tele-attachments range from 3 to 8 magnifications, Goerz types 3 to 9, and there are similar offerings by Dallmeyer, who was the pioneer, Zeiss, Voigtlander, Ross, and others.

Grandacs are complete systems using same telepositive, 10 in. F:4, which will also work alone. With No. 1, it gives magnifications 2¼ to 4, on 3¼ x 4¼, with 6 to 12-in. bellows, maximum speed F:10. No. 2 is for 5 x 7, and ranges 3 to 5 powers, maximum speed F:11. Gundlach Pancratic telephoto is an inexpensive complete system giving 3 to 8 powers. It substitutes for ordinary lenses in standard opening shutters on hand cameras. Tele-Peconar, F:5, works complete at 3–5 magnifications, or can be used with back lenses of symmetrical types or as a lens for large portraits.

The Adon is complete, with 4½ in. front lens and negative of 2 in. giving variable magnifications from two times up, and, at same bellows as ordinary lens, a triple enlargement.

Very low powers are more conveniently produced by the single convertibles or by supplementaries like Distar or by substitution elements of the Aldis Duo and Trio type, mentioned under convertibles. For fast work, the fixed-focus one-magnification lenses next described are necessary. By dispensing with variable magnifications,

higher correction and speed can be attained. The first introduced was the Zeiss Magnar F:10, focal length 18 in. and back focus only 6 in. Busch Bis-Telar, F:9 and F:7, and Cooke Telar, F:7, work similarly, but with back focus one-half of equivalent. Other typical lenses are Telecentric, F:5.4 and F:6.8; Large Adon XI, F:4.5, Dallon Anastigmat Telephoto VI, F:5.6, and XVI, F:7.7, the last one compact enough for shutters on hand cameras. The Telestigmat, F:6.8, gives like others of this class, an image double the size of ordinary lenses which just focus in the same bellows.

Wide Angle Lenses are necessary evils. They are of short focus in proportion to the base line of the negative and never should be used where longer focus lenses will also work.

Precise anastigmats like Protar V, F:18, give extreme angles. Somewhat less angle, but greater speed comes with Protar IV, F:12.5. Other lenses are Collinear IV, F:12.5, Ross W. A. Anastigmat, F:16. The Goerz Hypergon, giving 135° angle, handles almost impossible interior or architectural conditions. A revolving star diaphragm is used to equalize illumination.

All lenses with reserve covering power are potential wide angles. You can use the Goerz Dagor up to 90° angle and have wonderful convenience of focusing with large aperture and lots of light. Protar VIIa and others can be used. Some large aperture lenses are made primarily for wide-angle work e. g. the Cooke Primoplane, F:6.5; Velostigmat III, F:9 and Zeiss IIIa, F:9.

CHESTER F. STILES

Books

Of the many useful and profitable books dealing with photographic lenses published during the last twenty years, only two or three are in print and available. These are:

OPTICS FOR PHOTOGRAPHERS. By Hans Harting. Translated by Frank R. Fraprie. 1918. 224 pages, with diagrams. $2.50

A TREATISE ON PHOTOGRAPHIC OPTICS. By R. S. Cole. 1900. 325 pages, diagrams. $2.00.

How to Choose and Use a Lens. (Practical Photography Series.) 83 pages. Paper, 50 cents; Cloth, $1.00.

Soft Focus Effects in Photography. (The Photo-Miniature Series, No. 184.) 1921. Paper covers, 40 cents.

Telephotography. By C. F. Lan-Davis. Second Edition, 1921. 112 pages, illustrated. Cloth, $2.00.

Modern Telephotography. By Captain Owen Wheeler. 1910. 80 pages. Paper covers, $1.00.

Out of print books, which may be seen at some of the larger libraries, are: "The Lens" by Bolas and Brown; "A First Book of the Lens" by C. W. Piper; "The Optics of Photography" by J. Traill Taylor; "Photographic Optics" by O. Lummer; and "Elementary Tele-Photography" by E. Marriage.

Notes

An Ingenious Depth of Focus Chart, which completely solves the "depth of focus" problem for any lens at any given aperture and object-distance, has been prepared by H. W. Lee, of Taylor, Taylor & Hobson, Ltd., the makers of the well-known Cooke Lenses (American Agents: Burke & James, Ltd., Chicago and New York).

This chart, which will prove invaluable to photographers, consists of two diagrams: Fig. 1, on which are plotted vertical and horizontal lines representing various focal lengths and object-distances, and Fig. 2, a transparent film with radial lines representing the lens apertures (F: and U. S. systems) in common use. By placing Fig. 2 in position over Fig. 1, the depth of field with any lens and stop may be found at a glance.

By the aid of this chart the photographer can make a Table of Hyperfocal Distances and Depth of Field for his lens or lenses within a few minutes. A supply of printed blanks, vest-pocket size, is included with the chart, which can be obtained from Burke & James, Inc., for the nominal sum of 25 cents.

A New Eastman Portrait Diffusion Disk has been added to the existing series: No. 0 for lenses of from 2 to

3¼ inches in diameter. In this size the E. P. D. D. is available for use with many lenses now used for enlarging, and for this use will be found more efficient than chiffon and similar devices since it does not increase the exposure. Another Eastman lens introduction is the Kodak Anastigmat F:4.5 in two new sizes, viz. 10 and 12 inches focal length respectively, especially useful in home portrait work.

Dallmeyer Lenses in America. I note with pleasure that the justly celebrated Dallmeyer lenses are being prominently displayed by many dealers—a welcome post-war revival. The new Dallmeyer catalogue describes and illustrates many desirable additions to the oldtime favorites, among which may be mentioned the New Large Adon, a fixed-focus telephoto lens with the remarkable aperture of F:4.5, for reflex and focal-plane cameras; two new sizes of the Dallon Anastigmat Telephotos for folding hand cameras of short bellows extension, working at F:6.5 and F:6.8; the Perfac, F:6.3 a moderate price unsymmetrical anastigmat for single extension hand cameras; the Serrac, F:4.5, and the Pentac, an anastigmat with an aperture of F:2.9, with which an adjustable diffusion device is supplied in the larger sizes.

An interesting report on "The Manufacture of Optical Glass and of Optical Systems" in America has been issued by the Government Printing Office, Washington, as Ordnance Department Document No. 2037, price 75 cents. Readers not already satiated with the lens information given in this issue of The Photo-Miniature will find useful "supplementary reading" in this report.

PLATE 1. SIXTH AVENUE, NEW YORK
Pittsburgh Salon, 1922. San Francisco Salon, 1922
$2\frac{1}{4} \times 3\frac{1}{4}$ Icarette negative, 10 x 12 print

BEN J. LUBSCHEZ

PLATE 2. SUNLIGHT AND SHADOW

Royal Photographic Society, London, 1921. Oakland Salon, 1921
Members' Exhibition, Camera Club of New York, 1921
$2\frac{1}{4} \times 3\frac{1}{4}$ Ansco Speedex negative, 11 x 14 print

BEN J. LUBSCHEZ

PLATE 3. COLUMNS

Toronto Canadian National Exhibition, 1921
Members' Exhibition Camera Club of New York, 1921
$2\frac{1}{4} \times 3\frac{1}{4}$ Ansco Speedex negative, $6\frac{1}{4} \times 14$ print

BEN J. LUBSCHEZ

PLATE 4. THE CABBY
Print from original negative without modification
$2\frac{1}{2} \times 4\frac{1}{4}$ Speed Kodak negative
BEN J. LUBSCHEZ

PLATE 5. THE CABBY (from same negative as 4)
Pictorial Photographers of America, New York Exhibition, 1921
Members' Exhibition, Camera Club of New York, 1921
14-inch print from about 1 inch of negative, picture reduced to simplest form with all detracting elements cut away

BEN J. LUBSCHEZ

PLATE 6. AN OLD COURTYARD, NEW ORLEANS

Print from original 3¼ x 4¼ negative, unmodified

BEN J. LUBSCHEZ

PLATE 7. AN OLD COURTYARD, NEW ORLEANS

Bromoil about 7 x 9 from same negative as 6
Much simpler and broader with detail softened and objectionable detail eliminated. Note improvement of composition by simplification and trimming

BEN J. LUBSCHEZ

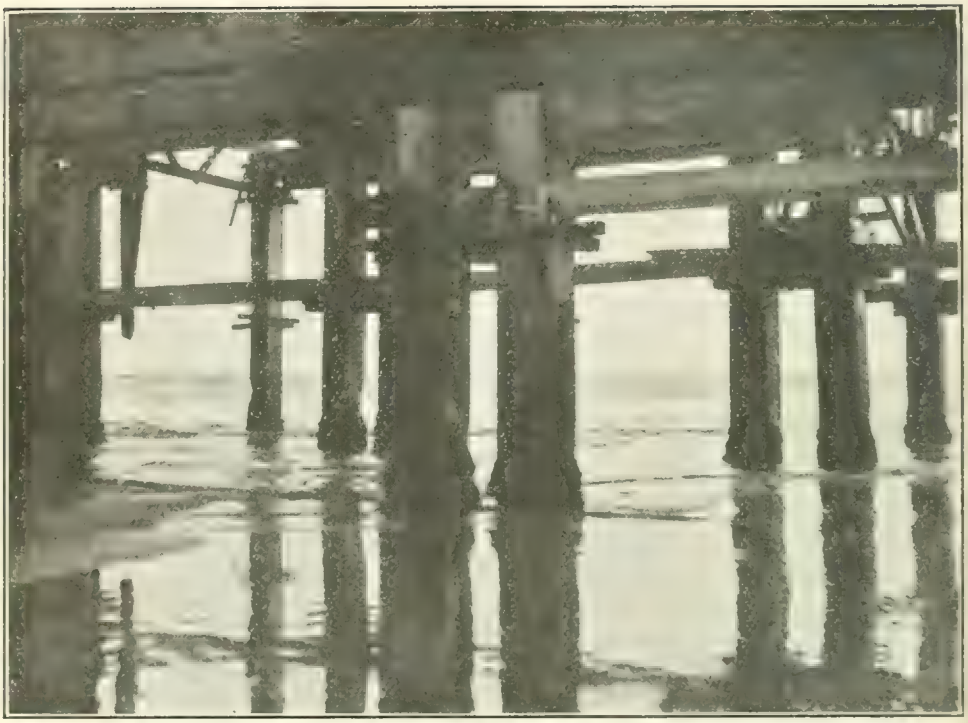

PLATE 8. UNDER THE PIER

San Francisco Salon, 1922

$2\frac{1}{4} \times 3\frac{1}{4}$ Icarette negative, 11 x 14 print

Interesting for its bold pattern, almost Chinese in character

BEN J. LUBSCHEZ

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The Exhibition Print

The aspiration of most amateurs from novices up is to be able to make prints the equal of those they see at exhibitions or in the various better photographic publications. They have the same cameras, use the same films or plates and the same papers, some of them are quite adept at the same processes, then why not just as good pictures? Because making a picture is not a mere mechanical process. Because the technically fine carbon, gum or bromoil print is not necessarily a picture. Because a print may be as fuzzy as it is possible to make it and the scent of the commonplace and ignorance may be with it still. The exhibition print is something more than a good print from a good negative of an attractive subject. The good picture must be made with heart and soul, and with knowledge and a bit of a dream in it.

In the making of pictures by photography there are, of course, processes and methods of procedure. Processes are comparatively much less important than methods of procedure. It would be idle to attempt to consider the almost infinite number of photographic processes in this brochure. It would be equally idle to consider the intimate and complete technique of any one process, this having been done already in many previous monographs in this Series. Here, then, we shall consider primarily methods of procedure only. We shall leave to each worker his own favorite subject and his own favorite process; but we hope to show him

at least the beginning and the direction of the road whereby he may reach a point beyond the mere technicalities of his process, and enable him to present his subjects in a way which will arouse in others the emotion they arouse in him. It is such presentation which is the prime essential in picture making from the first step to the last, from the taking of the negative to the titling of the mounted print. We lay stress on picture making, because the print which is considered for exhibition or publication must first of all have pictorial quality.

What is a picture? According to the dictionary: any graphic presentation of an object on a flat surface (why flat only?), made by drawing, painting, etching or any method, is a picture. According to this, then, all photography is essentially pictorial. But usage changes the meaning of words, and we now recognize pictorial photography as something quite apart from what we are pleased to call mere record photography. The distinction is erroneous because all photographs are in their nature records, modified, perhaps, but records still.

The popular meaning of pictorial, then, seems to be related to something more esthetic than mere graphic record, to something which has to do with beauty. Let us say, then, that a picture is a beautiful record; a record which arouses a reaction in the observer similar to the reaction felt by the recorder and which prompted him to make the record. Unless a picture does this, it has no reason to exist as such. Unless it does this, it is simply a record and nothing more.

The Appeal of the Picture. A record having qualified as a picture, its worth as such depends upon the mood or story it records, the composition or arrangement of its parts, and on a certain quality which may be called character. Composition, whether pictorial, literary, architectural or musical, is essentially a putting together of parts or elements. Good composition in a picture is a putting together of its elements in a pleasing and harmonious way, and in keeping with and furtherance of the mood or story illustrated, and bad composition is the opposite.

Pictorial Material. The infinitely varied moods of nature, and the stories of the various activities and speculations of man, have furnished the material for all of man's pictures from the very beginning of graphic representation and recording. Most human beings come in contact, constantly, with beautiful moods and stories and cannot see them. Of those who can and do see them, the great majority can make no record of them. This majority has been greatly lessened by the popularization of photography, for photography has eliminated the protracted training necessary to acquire skill in drawing, painting or their variations and dependent arts. Recording beauty by means of photography is more or less a mechanical process. In other words, photography is not a creative art but a method of representation.

The third essential quality of a picture, character, is not easily defined. It is closely akin to what we mean by character in anything. It is that quality which makes it easy for the observer to recognize the maker. It is a combination of technique, color scheme, tonal range, idiosyncrasies of composition and choice of subject.

Picture Making by Photography now resolves itself into three essentials. First, the selection of a beautiful or worth-while mood or story to record. Second, the proper composition or putting together of the elements of the record, it being remembered that the control of composition in photography is severely limited in comparison with that possible in other graphic processes. Third, the selection of the most appropriate process, materials and technique for the record, always remembering our single aim, to bring about a reaction in the observer similar to the one felt when making the record or when deciding to make it. With these three essentials provided for, character comes automatically, for it is the aggregation of them.

The Pictorial Sense. It is quite obvious that we cannot make pictures until we can see pictures. To be able to see pictures, one has to have some of that elusive thing called pictorial sense, rarer even than common sense, one of the most uncommon things on

earth! With some, pictorial sense, like common sense, is instinctive and innate; others do not even seem to know what it is. Unlike common sense, however, pictorial sense can be cultivated to some extent by every intelligent human being.

Learning to See. To be able to see pictures, one must learn to know pictures, not merely to be generally familiar with them, but to know them; to know their structure and their anatomy, as it were; to know the source and reason of their beauty and charm. To learn all this about pictures, we must study them. Let us assume that you are looking at a picture which pleases you very much. Why and how does it give you pleasure? Analyze it and discover its elements of beauty. Study its character and study minutely the qualities which give it its character. Study the subject, the mood or story portrayed. Study the composition, how the parts are placed in relation to each other and in relation to the frame or whole shape; how balance is secured, balance of line as well as balance of tones and values. Study the key, whether high and light, or low and dark. Study the tonal quality, whether rich and warm, or subdued and cool; whether strong and bold with great contrasts, or subdued and soft. When you have formed your opinion about each of these various qualities of the picture under consideration, try to determine what each contributes to the quality of the whole. In that way you will learn how to plan various results in your pictures by varying and modifying the different constituent qualities. If the picture does not please you, a similar analysis will teach you just as much. You will learn just as much, sometimes even more, by studying out carefully just why the picture does not please you. The important point is that you should never dismiss a picture from your mind until you have decided just why you do or do not like it. You should analyze every picture you see and you should make it a point to see many.

Material for Study. At this point some one in the audience will rise and say: "I live several blocks beyond Main Street and real pictures worthy of study are scarce and besides I don't know what pictures to study."

To both of these comments, we must answer that the gentleman is entirely mistaken. Good pictures are available wherever good illustrated magazines circulate, and that is pretty much everywhere. Cheap reproductions of the finest pictures in the world are easily procurable. The Metropolitan Museum of New York and the art galleries of many American and European cities publish excellent reproductions of the masterpieces in their collections, at nominal prices. Every town of size nowadays has its library and nearly every library has well illustrated books, good prints, and reproductions of great pictures. In the larger cities, the field for pictorial reference is, of course, much broader. And there are many series of reproductions offered for sale. As to the kind of pictures to study it really does not make much difference at first. You will naturally be interested in pictures you like and you will never consciously make a picture better in quality and character than what you like. When you learn to like better pictures, you will probably make better pictures. The all important thing is to learn to analyze pictures and to learn to see pictorial possibilities and pictorial quality. The next important thing is to be able to find out just why you like or dislike a picture. As a rule it is better to begin with pictures in one color, for the photographer usually works in monochrome and is apt to be misled by color. This is why etchings, monochromatic lithographs, various other prints and photographic reproductions of paintings are so good for study by photographers. When possible, the comparative study of a painting and its photographic reproduction is excellent in training the pictorial photographer to translate polychrome into monochrome, as he has to do when working from nature.

Observation of Nature. As you gain a knowledge of pictures, watch for the natural pictures about you. They are everywhere in what seem to be the most prosaic places. Limit what you see by an imaginary frame or more easily by looking through a rectangular cardboard or wire frame, (direct view finder). By moving this frame or finder towards and from the eye, more or less of the composition may be taken in. Being able

now, let us say, to see pictures lurking in places you never dreamed of before, you wish to make records of them by photography. We must realize at this point, that a technically perfect photograph of this picture will not agree with and represent faithfully what you see, for various reasons. The angle of view of the eye is not so wide as that of the usual lens and therefore the photograph will show a greater field than that seen by the eye. The eye sees less keenly and less distinctly than a good lens, hence the photograph will be sharper and contain more detail than the visual image. Normal plates and normal exposures certainly do not render values as seen by the eye, and these are not seen alike by any two pairs of eyes. We must then learn to control and modify our photographic processes so that they will record as accurately as possible what we see and what we wish to convey with our picture.

Composition. Having discovered the mood or story or other subject of the picture, the next and extremely important consideration is the composition. Here the draftsman or painter has a great advantage over the photographer. The painter may place objects in his picture at will, he can change their natural position as he thinks best, he may change tones and values as he likes, to help the composition. In the photograph these elements are, to a great extent, fixed. They may be modified and somewhat controlled in various ways especially as to values and the relation of the elements to the whole picture. Before discussing these ways, however, we must consider the subject of composition in so far as it may be formulated.

Perhaps the most important consideration in the making of a picture is its composition, the putting together of its various elements and parts, their relation and their juxtaposition. A sense of composition may be acquired in much the same way that pictorial sense may be acquired, by observation and analysis. When you see a composition which pleases you, find out why it does; and if it offends you, likewise find out why. Analyze as many compositions as you can. It might be well, at least in the beginning, to take it for granted that recognized masterpieces have a just claim

to their reputation, and to try to find the reason for the reputation.

Do's and Don'ts. There are no rigid, inflexible rules for composition, although we have heard much about such rules. There are a few elementary do's and don'ts that have become almost axiomatic. The best list of these, one which has been of the greatest help to me, was formulated some years ago by the late David A. Gregg, one of the foremost pen and ink draftsmen of America. Mr. Gregg probably taught and inspired more students to do beautiful work than any other one man. The list, paraphrased from memory and with comments under each item, follows:

1. **Consider the Direction of the Light.** The direction of the light obviously has a great deal to do with the composition of a picture. It determines the form and extent of the shades, shadows and lights of the picture—all the elements the photographer has to deal with. Very often, of course, one has to catch the picture at the moment; but when one can deliberate and experiment, the scene or subject chosen should be visited or, better still, photographed at different times of the day and year, to select the best and most appropriate lighting. In studio work, of course, the photographer completely controls the lighting of the subject.

2. **Accent and Interest.** Have a leading dark accent and a principal point of interest. This is important and means much. Most photographs have too many scattered accents and points of interest. They usually contain several latent pictures. Learn to simplify. Have one principal accent and one leading interest.

3. **Have a Larger Light Area.** This is more directly applicable in studio photography, drawing and painting, where the lighting of the subject can be controlled at will, but can often be employed in outdoor work. It should be kept in mind and taken advantage of whenever conditions make it possible to have this large balancing light area.

4. **Get Three Predominant Values at least, black, grey and white.** The tendency in photography is to include too many values. "Simplify" is the golden rule

in composition in photography; generally the pictorial value of a photograph is in direct proportion to its simplicity, but it takes at least three values to make a picture.

5. Keep Interest Out of the Corners. This is one of the most important things to remember in composing pictures. To make your leading point of interest count, and this point should rarely, if ever, be central in the composition (see Plate 6), the edges and corners should be subordinated in interest. Nothing is more distressing in a picture than to make the eye wander around the edges and corners by scattered attractions, thus diverting the attention from what should be the principal point of interest somewhere in the field.

6. Do Not Divide Your Picture into two approximately equal parts, either horizontally or vertically. This is a familiar, elementary rule. No accent or strong line, such as the horizon or a dark tree, should bisect the picture in either direction. Symmetry is an excellent thing to avoid in picture making; balance is essential. The difference will be explained later.

These are all sound principles, although I have seen good pictures which violated nearly all of them. For the beginner, they are certainly wise and safe rules to remember and to use; they will build for him a sound foundation and at least start him on the right road.

Helpful Principles. John V. B. Van Pelt in his book, "A Discussion of Composition," lays down the following principles:

1. The interest must be focalized and have its most potent expression in one point.

2. The number of secondary focal points must be reduced to a minimum; where such points exist they must be conceived primarily in regard to the climax and in their comparative importance must work up to it.

3. Of the different minor elements of the composition each, perhaps, relating to its own especial focal point, must still feel the influence of the climax.

4. In a pictorial composition the different elements must balance in such a manner that the average of interest will fall in the center of the frame.

5. That the different elements of a composition, climax, secondary climaxes and sub-motives, may attain to the highest interest, they must contrast one with the other.

6. That unity exist in the composition, the laws of harmony must be observed, and no foreign element introduced.

In the last analysis, these rules by Mr. Van Pelt will be found basically similar to the simple rules laid down by Mr. Gregg. Another excellent essay on composition will be found in the second part of Letter III in Ruskin's "Elements of Drawing." It would well repay every aspiring pictorialist to read and study this chapter.

Balance. Before we leave these rules, we must clearly understand what is meant by balance. Balance depends on the old mechanical rule of the lever; a weight of two pounds at one foot from the fulcrum will balance a weight of one pound at two feet from the fulcrum on the opposite side. So in pictures. A small area of an intense color or value will balance a much larger area of correspondingly less intense color or value on the opposite side of an axis. It is well to have a line which slopes distinctly in one direction balanced by a line in a contrasting direction, so as to avoid the appearance of rotation. We must also remember that a small area at a distance from the axis will balance a larger area on the opposite side of the axis but much closer to it; the product of one area and its distance from the axis equals the product of the other area and its distance. Likewise with varying intensities in a balanced relation. The greater intensity times the lesser area on the one side will balance the lesser intensity times the greater area on the other. When the elements of a balanced relation are exactly alike, we have symmetry—to be avoided, as already advised.

Applying Knowledge. What we learn about composition must not be applied to our own efforts only. It cannot be effectively applied to our own work until we have persistently applied what we have already learned to the study of pictures we see. We must not forget that to be able to make pictures, we must know pictures,

and to know pictures we must study them. The results of the study of pictures are cumulative to a surprising degree. The more knowledge we apply to the study of pictures, the more we see in and get out of the pictures; the more we get out of our study, the more knowledge we may apply to further study!

Design and Its Control. The composition of a picture is really its pattern or design. The painter or etcher has unlimited freedom in planning his design; its approach to perfection depends only on his knowledge and ability. Not so with the photographer, at best he can only modify somewhat and improve a pattern which already exists and is fixed, and his opportunity for doing this is quite limited. The control of composition in a photograph is dependent on only a few things:

1. **The Point of Station,** or where you place your camera. Great variation in the pattern or composition of your picture is possible by moving your camera from one place to another. Walk about and look at your subject from as many points of view as possible. Not only move about the ground or floor, but move up and down, get on your tiptoes, on a rock, or on a chair; get down on your knees or even flat on the ground. The great differences in composition will surprise you. There is one best point of view; find it before you make the exposure. Try several different exposures and study the results at leisure.

2. **The Focal Length of the Lens** in relation to the size of plate or film used. It is said that wide-angle lenses cause distortion in perspective. This is one of the things we know that aren't so. The angle of view of the eyes is about fifteen degrees; unconsciously we shift our eyes and see what is included in about forty-five degrees. That is why the usual lens is of about this angle. We must remember that if we cut out of a picture taken with a wide angle lens, the part included in an angle of view of fifteen degrees, this bit will be no more distorted nor unpleasant than if taken from the same station point with a lens of fifteen degrees angle of view, although the whole picture may include ninety or one hundred and twenty degrees and show much exagger-

ated perspective at the edges. This is why an enlargement of a small portion of a negative is so often surprisingly pleasing. When pictures are made by enlargement from parts of negatives, as is usually best for many reasons later explained, the angle of lens used is of minor importance. As moderation in all things is best, however, it is better to stick to the normal lens of about forty-five degree angle, unless special effects are desired. It must not be forgotten, however, that great changes in composition of the *negative* are possible by changes in the angle of lens used.

3. **Exposure** controls the tonal composition of the picture. Most of the tonal composition of the picture is usually controlled in the print and printing process, but we must not overlook the possibilities of control in the negative by variations in exposure. We may reduce the negative to a few simple values by severe under- or over-exposure, eliminating details which might otherwise appear obtrusive or make the picture spotty. It is well to make three exposures of some subjects: one much under-exposed, one normal, and one much over-exposed. You may be surprised to find that the real pictorial possibilities lie in one of the grossly erroneous exposures.

The Camera. This, then, is about all that can be done in so far as the original negative is concerned, and it is our consideration of how we are going to do things up to this stage which will determine the kind of camera we shall use. A great deal of buncombe about cameras and lenses needs to be exploded. Just as good negatives for pictorial purposes may be made with a two-dollar Brownie as with the most expensive camera equipped with a highly corrected anastigmat lens. Of course, the Brownie must be used within the limits of its field of usefulness and this field is, unfortunately, quite small. The better the lens and the better the camera, the greater this field becomes. The more meagre your equipment, the more nearly normal must your light conditions be, for instance. Broadly speaking, the best pictorial negatives may be made under favorable conditions with the simplest equipment. Not to be severely limited and handicapped by conditions,

however, it is well to have the best equipment one can afford. If I make but one negative of a subject, I like to have it clean and sharp and crisp, and to make all necessary modifications in the printing. As said before, for many subjects, I like three negatives, normal exposure, much less than normal, and much more than normal. I rarely make my small negatives with a soft-focus lens, and I do not think anyone should unless he uses a ground-glass screen focussing camera making a four by five negative or larger. I think, judging from my experience of twenty-five years with cameras of every type the market affords, that the ideal single outfit for pictorial work is a camera for pictures not larger than 2¼ inches by 3¼ inches, using either roll or pack film, equipped with a good lens working at F: 4.5 and a good shutter. The camera is small enough and light enough to carry at all times so that the emergency picture opportunity may be grasped; the film is small and inexpensive so that one need not hesitate to make numerous exposures of one subject, the lens is of short focus and consequently of great depth of focus, and the negatives are sharp enough, if taken with a reasonably good lens, to stand many times enlargement. I also prefer a wire-frame, direct view finder. This device is even superior to the ground glass as an aid to study of composition.

For those who can afford more than the single outfit, a good view camera and a reflecting type camera are desirable additions. This is not a treatise on apparatus, however, and we must get on with our picture. Before we do, we must have another word or two on making the exposure. Do not be afraid of or timid about the unusual view point. The canyon like appearance of a narrow street with tall buildings is often better expressed from above than from the pavement, for instance. Views from behind a silhouette of columns or trees often have fine scale and depth. Do not be afraid of the unusual, try to find it, but avoid the grotesque. Again a plea for simplicity; a picture full of intricate detail is hardly ever more than an interesting record. A panoramic photograph is hardly ever a picture, but rather it may be a series of pictures invisibly joined. Do

not try to get too much in one negative. Remember it is the simple, bold picture that carries well and speaks forcibly. The human mind can grasp but one thing at a time well.

The Print. We now have some negatives with which we wish to experiment. With amateurs, these will usually be no larger than post-card size, usually smaller, but it does not matter. A contact print proof will be useful, but much better for our purpose will be straight, unmodified enlargements about 8 by 10 inches in size. By means of such proofs we shall determine our procedure to the end of the final pictures.

Finding the Picture. The first thing to do, recalling what we have learned about composition and from the study of pictures and also recalling what inspired us to make the negative, is to search the proof before us for that picture and the most satisfactory composition. We may find it in a space an inch by an inch and a half on an 8 by 10 print, and when we find it we must be merciless and not afraid to trim every bit of superfluous print away. By using a pair of L-shaped masks you must try eliminating various parts of the proof before you, especially at the edges, until you determine the really vital part of the print, the part which gives your future picture and the best possible composition. Bear in mind especially to attain: 1. The utmost simplicity consistent with the subject of your picture. 2. Unity and harmony. 3. A balance of tones and lines. 4. Elimination of all elements of distraction at edges and corners; these elements may in themselves be interesting but if they distract from the principal point of interest, obliterate them! 5. And above all, one principal point of interest.

Choice of Process. Having found the part of the proof which contains the real picture, you must now decide what to do with it. It may be that a contact print of good quality of the part of the negative represented will be as far as you care to go, but this will rarely, if ever, even begin to realize the pictorial possibilities of your negative. The better way is to decide on an enlarged print, either by direct enlargement from the negative or by contact printing from an enlarged

negative. It is well to mask or mark the original negative so that the part to be used as determined by the proof, will be plainly evident for all future manipulations. If this is not done, always have your trimmed proof as a guide for your after work. From the proof should be determined what tones need modification, if any; what details need softening or entire elimination; what color and tone the finished print should be; how soft and how "fuzzy" the finished print should be; whether the final print should be in the normal key or whether it would be better in a higher and lighter or lower and darker key. It should also be determined what texture of paper is most appropriate and desirable.

Combination Printing. At this point it should be decided as to whether combination printing should be used; that is, whether a sky or background or middle ground should be printed in from other negatives than the original. Although wonderfully beautiful results have been obtained by quite complicated combination printing from several negatives, as in the work of A. Horsley Hinton and W. E. MacNaughton, it is doubtful whether beyond the occasional printing in of a sky, the practice is really worth while. Any process or manipulation in picture making from boiling in oil or smoking with tar up or down is justifiable if the result is enhanced by that process or manipulation. There is great danger in combination printing, however. Few photographers possess the exceedingly nice discretion necessary to choose negatives of harmony for combination printing, in fact, it is a rare coincidence when two negatives made at different times and in different places are in proper harmony for combination. We often find in combination prints, a slight difference in lighting or a maladjustment of tones which is distressing to the trained eye. For those who want to try combination printing, first hand information can be obtained in Numbers 50, 61 and 170 of The Photo-Miniature Series.

Controlling the Result. Experimental proofs of various kinds from the chosen part of the negative may be necessary to determine, finally, all these factors; but

we should remember that all the details of color, tone, softness, key, texture, have their effect on the composition, in telling correctly the story our picture is to tell, and in giving it character. The determination of these factors will point out the process to be used or the proper manipulation of our favorite process. We may be able to accomplish all we want to by ordinary bromide enlargement. This is the simplest and most straightforward process for real pictorial work, and my favorite. Great control is possible. Black, a full range of browns from red chalk to warm black, and even blue and green color tones are available on both white and buff papers. There are numerous textures among the varieties of paper on the market. Then, of course, there is bromoil, a process so flexible and so full of possibilities of control in every way, that it is dangerous in the hands of most pictorial workers. I believe that the knowledge and ability which will enable the photographer to take real advantage of the possibilities of control in bromoil for the pictorial good of his work, will enable him to make his photographs so that little manipulation and modification in his print will be necessary. Again the enlarged negative gives you not only all the advantages and benefits of control and modification possible in projection printing, but in addition the further possibilities of all the contact printing processes, carbon, gum, platinum, oil, kallitype, and their variations.

The Bromide Print. The flexibility of bromide enlarging is not taken advantage of fully by most workers. Remember, when you project an image on a piece of bromide paper, that you are in a position to actually *paint a picture with light.* The light which makes the image on the paper may be absolutely under your control. Three simple devices give you this control. A small disk of cardboard or heavy paper about an inch in diameter, or less for small prints, fastened on the end of a stiff wire about eighteen inches long, will enable you to cast a shadow on any part of the print and thereby hold back the printing where the shadow falls. By moving the disk backward and forward the size of the shadow may be varied and by vibrating the disk or

moving it about slightly sharp edges are avoided. A piece of cardboard with a small hole in it may be used to throw a spot of light on any part of the print, its size depending on the distance of the hole from the lens, thus increasing the depth of printing in any part. A plain piece of cardboard—I usually use the card packed with the paper—is most useful for shading large parts of the image, as for instance shading the foreground while allowing the sky to print. If the light is too strong or the negative too thin to allow enough printing time for control (you should have at least thirty seconds), then a light, say five times, color filter is useful. The color filter will also increase contrast somewhat and is therefore useful in strengthening prints from thin negatives. A sky filter or graded ray filter may often be used to advantage in grading the values of a print from top to bottom or vice versa. It is especially useful in grading the sky tone. If the sky in the negative is blank and uniform in value but not too dense, a beautiful sky may be printed through a sky filter, the yellow part holding back the foreground and the clear part allowing the sky to print. It is best to use the filter for only part of the time of exposure.

With these three cardboard assistants or substitutes for them—I often use my hand or finger-tip—interposed between the enlarging lens and the bromide paper, at various distances, in various positions, held still, shaken or vibrated, you may get almost any kind of a print you want from a reasonably good negative. No rules can be given, new possibilities will occur to you as you work.

Modifications. There is also the modification possible by over or under exposure. We should try proofs exposed in different ways to determine which is best. Extreme variations in prints from the same negative are possible by varying the exposure. Then there is the matter of softening the edges and soft focus effect. The oldest method of softening the lines of an enlargement is probably by the use of a bolting silk screen at or near the sensitive paper. A chiffon screen may be used over the lens. Shaking the paper holding the easel for about one-third of the time of the exposure is a favorite trick

of N. E. Luboshez, the eminent London worker. Merely throwing the image on the paper slightly out of focus is often very effective. The use of a soft-focus lens for making the enlargement opens up a fascinating and almost unlimited field. Part exposure with the full opening of a soft focus lens and a gradual stopping down of the opening for the remainder of the exposure, is an effective dodge. The newly invented Eastman diffusion disks are also simple and effective and capable of much latitude in results. For most subjects, an enlargement gains much in pictorial and vibrant quality by at least a slight softening or diffusion in focus; the best amount can only be determined by experiment in each case.

Don't Overdo. Broadly speaking, too much modification is worse than too little. Restraint is good in all things. Photography often renders contrasts and values untruly and modification in printing is desirable, but this modification must be done with knowledge beforehand. We must know just what we want to do and why. The photograph on which we are working is to be the record of a mood and impression, a record which is to bring about a similar mood and impression in the observer; everything we do from the release of the shutter to the mounting of the finished print, should be done with this object always in view. The enlarging process, printing by projection, not only gives the worker wide opportunity for printing control, but it tends to separate the planes of the picture, to add transparency to the shadows, to open up the picture, as it were, and to give it depth and the third dimension.

Other Processes. The bromide enlargement may be the end and a worthy end, or it may be merely a step towards the end. In its positive form it may be bleached and tanned and inked up with greasy ink as in the bromoil process, giving an unlimited possibility of color and tone control,—a control, as I have said, dangerous except for the pictorially intelligent and sophisticated. Or by chemical treatment and bringing into contact with prepared carbon tissue, carbon prints may be made from the original bromide print by the Carbro process, giving the wide range of color and

texture and charm of the carbon process. Also, as already suggested, the bromide print may be toned, redeveloped, intensified or reduced.

Enlarged Negatives. An entirely different range of possibilities is available by beginning with a positive made by contact or projection from the original negative instead of with the negative itself, (Eastman's Process Films are excellent for this), and then making an enlarged negative on film or paper by contact or projection. I prefer making a positive on film by contact or if the part of the original negative used is quite small, by projection to about four by five inches. A great deal of modification is possible in the making of this positive, especially modification in softness and contrast. The positive transparency may also be retouched. From this positive may be made a negative by projection, if eight by ten inches or smaller, on film, if larger, on thin bromide paper, with all the possibilities of control and modification inherent in the enlarging process. From this final enlarged negative, a print may be made by any contact printing process. Some of the finest gum prints I have ever seen were made from enlarged paper negatives. The remarkable exhibition of carbon prints by Alexander Keighley were made from enlarged negatives, probably on paper, judging from the texture of the prints. The enlarged negative may be worked over, retouched and otherwise modified and this whole process of working from enlarged negatives adds another opportunity for control and modification and for bringing the final print into accord with our original vision, the real goal of our pictorial activities.

Summarizing the procedure to this point, we should:

1. Make sure about our pictorial sense. Improve it by careful study of pictures and nature and by regarding the principles of composition in this study.

2. Use this pictorial sense in the choice of subject and point of view. Walk all around the subject, try viewpoints below and above the normal height of the eye. If possible, consider the subject under different conditions of light and atmosphere. Make several negatives under these different conditions and with different exposures. If you get the right negative, it will be worth

all the trouble, but whether we get just what we want or not, we shall gain experience and wisdom anyway and our next attempt is likely to be more successful.

3. Make a normal positive proof from the best negative and study this proof, to determine the part of the negative we really want to use. Unmercifully trim away every part of the proof which detracts in the least from our getting the picture we started out to get and from making the composition as pleasing as possible.

4. Study the trimmed proof or subsequent proofs of the part of the negative we have decided to use, with the view of determining whether the finished print should be made by contact or by enlargement, directly or from an enlarged negative, in what key and how soft, what texture of paper and what tone or color.

5. Choose the process or procedure of our favorite process which will best give us what we have determined to get.

6. Carry out our intentions. If the results are not satisfactory, we must find out why and begin over as far back as is necessary to correct our mistakes, and repeat until we are quite satisfied that we have done the best we can.

Print Criticism. Before we take the final step in the making of our picture, we must not overlook the fact that the print which is seemingly finished may often be improved by more trimming, by toning, by staining, or perhaps by remaking altogether in the same or some other process! Let us look at this print critically and apply all we have learned to its consideration. Let us lay those L-shaped masks on it again and see if something near the edges is not still superfluous. Let us make sure that we have reduced the print to its simplest terms and that we have presented our story or mood in the most appropriate language,—tone, color, texture, key, softness. It is often well to lay aside a print for a few days or weeks, especially one which has been worked on for some time. A reexamination after a lapse of time may reveal many things that might be done to better it. It is surprising what a fresh inspection of a print will reveal.

Mounting and Framing. Assuming now that our

print is really finished and satisfactory; that we have trimmed off the last eighth of an inch; that it is perfectly square with itself and the world; that all spots and blemishes have been retouched and spotted out; that it is worthy of our character and reputation, and that it is capable of passing on the reaction to a beautiful moment experienced by us when we began by making our exposure, what now? Unless we wish to present our child to society in dishabille or negligee attire, we should mount, frame or somehow finish off this print of ours. And it is surprising what a difference in the print, different mounts and frames will make. The fashion in mounting and framing has simplified itself very considerably in the last ten or fifteen years. Time was when the photographer had a stock of paper and cardboard on hand, ranging from white to black with all the possibilities in cream, gray, buff, tan and brown in between. For every print, colors and tints were carefully selected and from one to three, or even four, submounts were used over the general mount. Double and triple mounting were the rule rather than the exception. But this has all changed. White, gray and cream are almost universal in exhibitions. Very little multiple mounting is seen.

If the print is large, mounting on a card of the same size as the print and binding the edges with passepartout or other paper of appropriate color is quite effective. A small frame gives a similar, but richer effect. The print may be most effectively mounted in a sunken panel, which is easily made in the mount by running the finger or an embossing roller around the edges of a cardboard form placed beneath the print, on a board or table. The print may be double mounted by using a slightly different color, tint or texture of paper just a little larger than the print for the secondary mount. It may also be double-mounted using the same paper for both mounts. If the paper has a distinct grain and the grain of the secondary mount is placed at right angles to the grain of the primary or large mount, the result is excellent. The mounted picture may also be matted or even double-matted; usually, however, the simpler mountings are the best.

Framing is not so important to the photographer as mounting for exhibition pictures are seldom framed. In general, the color of the frame should harmonize with the color of the picture, and it should be strong enough to limit the picture and separate it from the wall on which it is hung. A print with a wide mount should have a comparatively narrow frame and vice versa. Large prints and bold prints with strong contrasts look best when framed in rather strong frames without mounts or mats. The good frame never asserts itself, never detracts the eye from the picture itself, but quietly and definitely holds the picture together and separates it from its surroundings.

We must remember that mounting and framing, especially mounting, are additional factors in the composition of our picture. The composition may be apparently modified by the relation in size of the print and the mount and by the position of the print on the mount. A comparatively small mount tends to increase the apparent scale of the picture, a comparatively large mount, to dwarf it. A light colored mount will seem to lower the key of or darken the picture, and a dark mount will do the reverse.

To acquire taste in mounting and presentation of prints, we may follow the same course we did in the study of composition and pictorial quality. We must study what the ablest workers are doing, we must go to exhibitions at every opportunity, determine why we like what we do and why we dislike what we do, and profit by our study. There is no royal road or alchemist's formula.

Titles. Exhibition prints must usually be titled for cataloguing purposes if for no other reason. It is not always easy to find or make up a good title. In the case of a portrait the name of the subject is the best possible inscription; the use of the word "Portrait" alone is exasperating, the use of "Portrait Study" utterly abominable. With other subjects the title should be short, as simple as possible and at the same time appropriate to the picture or descriptive. A good title should be euphonious, be easily spoken and remembered. Quotations, especially from poetry, should

be well considered. It is easy to make a title too poetic —and banal. So, too, a quotation often challenges criticism, and the picture may not measure up to the force or charm of the title or sentiment chosen. In making up a title, it is well, if a suitable phrase does not come to mind while making the print, to write a short sentence appropriate to or descriptive of the subject of the picture and, by the elimination or substitution of words, reduce the sentence until it epitomizes the whole thought. As to descriptive titles, these should cover the mood or atmosphere rather than the physical elements of the subject, although many a simple title which is merely a name will often prove most effective. The study of great pictures and their titles will be found helpful.

A Summary of Faults. Here, with the completion of that print we both began to make some time ago, it may be well to summarize and comment upon what has seemed to the writer to be the more common faults in prints seen at recent exhibitions.

First and chief, faulty composition, much of which could be vastly improved by the simple expedient of thoughtful trimming.

Carelessness in the disposition of prominent lines. Horizons which should be level sliding off to one side or the other. Vertical lines in the subject conspicuously out of plumb in the print. Most of these defects could also be corrected by the simple device of proper trimming. Certainly they could be corrected by proper tilting of easel in enlarging, when due to tilting of camera when making the exposure.

Failure to reduce the print to its simplest form containing but one picture and one principal point of interest. Much has been said about this already, but it seems extremely difficult for some pictorial workers to slash their photographs down unmercifully to the one most important picture they may contain.

The belief that an interesting or unusual process in making the print will in itself make a picture out of the photograph. Process may enhance a print or add pictorial quality, but it can never in itself make a picture out of a faulty photograph.

The belief that an unusual subject is necessarily pictorial. An unusual subject often lends itself to pictorial treatment. A commonplace subject can sometimes be treated pictorially from an unusual viewpoint, but the mere fact that its subject is unusual or its treatment is unusual will not in itself make the photograph a picture.

The belief that fuzziness is in itself essentially pictorial. It is not. Soft focus and fuzziness may be used quite effectively sometimes to give atmosphere and mystery and depth to a picture. It is often used merely to cover up a multitude of sins. In itself it may mean nothing more than a poor lens or careless lens work.

BEN J. LUBSCHEZ

BOOKS

In THE PHOTO-MINIATURE Series, Nos. 25: LANDSCAPE PHOTOGRAPHY; 42: GENRE PHOTOGRAPHY; 53: PICTORIAL PRINCIPLES; 59: COMBINATION PRINTING; 61: CONTROL IN PICTORIAL PHOTOGRAPHY; 170: CLOUDLAND AND SKY, and 176: THE SIGNIFICANCE OF DESIGN IN PICTURE MAKING are all helpful to the pictorialist. They are all, however, out of print and must be sought for at dealers or the public libraries.

PICTORIAL LANDSCAPE PHOTOGRAPHY, by The Photo Pictorialists of Buffalo, 216 pages, 53 illustrations. $3.50.

PICTORIAL COMPOSITION IN PHOTOGRAPHY, by Arthur Hammond, 212 pages, 49 illustrations. $3.50.

THE APPEAL OF THE PICTURE: An Examination of the Principles in Picture Making, by F. C. Tilney. 307 pages, 20 illustrations. $3.50.

ART PRINCIPLES: With Special Reference to Painting, by Ernest Govett, 377 pages, 29 plates. $3.50.

PICTORIAL COMPOSITION, by Henry R. Poore, 277 pages, profusely illustrated. $4.00.

THE FINE ART OF PHOTOGRAPHY, by Paul L. Anderson, 310 pages, 25 illustrations. $3.00.

PICTORIAL PHOTOGRAPHY, by Paul L. Anderson, 299 pages, 25 illustrations. $3.00. (The technique of negative making and printing.)

The Appreciation of the Fine Arts, by F. C. Tilney. One of the special courses issued by The Art of Life Movement, London, 1921. $20.

Better than all the books, as offering personal instruction and guidance in pictorial expression, is this special course by Mr. F. C. Tilney, an English painter, photographer and art teacher of repute. The course consists of six lessons, with illustrations and test papers, prepared for individual students or study-groups interested in picture making. I know of no simpler or more interesting way by which photographers can learn to analyze pictures and so cultivate the "pictorial sense" than that set forth in these lessons, in which the principles of art-expression and the appeal of the picture are clearly explained and illustrated. The test papers, with the answers to the student's questions furnished by correspondence, are of peculiar advantage as fitting the instruction to the personal needs of the student.

Exhibitions

The 1922 London Salon of Photography, which closed its doors last month, must have been a wonderful show. It would, however, be futile to attempt a detailed review without the pictures before us, so that I must content myself with the following notes, based on conversations with Pirie MacDonald, of New York, and George H. High, of Chicago, who, from their respective viewpoints as professional and amateur, pronounced it to be the most interesting and satisfying exhibition of pictorial photography they had ever seen. Detailed reviews of the Salon can be seen in *The Amateur Photographer* and *The British Journal of Photography* of September 15th and 22nd.

About 4000 prints were submitted, of which 415 prints were accepted and hung—all that the galleries could accommodate. These 415 prints were sent by professional and amateur photographers of Britain, the United States and Canada, France, Italy, Spain, Switzerland, Denmark, Norway, Sweden, Belgium, Holland, Russia, India, the Malay States, Australia, New Zealand, Egypt, Japan, South Africa and even the little principality of Monaco, so that the Salon was truly international in its make-up and afforded a fairly complete survey of the world's progress in pictorial photography.

The United States and Canada had a grand total of 115 prints accepted. In this list many of our best known American pictorialists were represented, but others were among the missing and there was a generous showing by new workers.

The dominant note of the Salon was the extraordinarily high quality of the work shown, the acceptance of prints evidently being based on finding brains and imagination in the work rather than mere technical skill or "clever stunts." The bizarre effects and sensational departures of former Salons were less in evidence this year, the majority of the prints exhibited being thoroughly good examples of "straight" photography,

i. e. showing little or no hand work in negative or print. The collection was exceptionally strong in portraiture and figure compositions, well thought out and brilliantly executed, generally sane in character and free from soft focus, spotlight and similar excesses. In the landscapes and decorative work shown two qualities were clearly apparent—a better understanding of the influence of design in picture making with the camera, and a deeper appreciation of tonal qualities in the print.

The Fourth Buffalo Salon is announced as to be held at the Albright Galleries of that city during March. Entry forms can be obtained from the Secretary, C. R. Phipps, 142 Dorchester Road, Buffalo, N. Y. the closing date for entries being February 1.

The Royal Photographic Society's sixty-seventh annual exhibition, London, September 16 to October 28, is reported to have been a notable success. A very complete survey of its varied features, with good reproduction of many of the exhibits in the different sections, may be had in the Official Catalogue and Special Exhibition issues of *The Photographic Journal*, the organ of the society, which may be obtained at 50 cents apiece from the Secretary, 35 Russell Square, London, W. C. 1. A careful estimate of the Pictorial Section, by F. C. Tilney, appeared in *The British Journal of Photography* dated September 23rd.

Unlike the London Salon, the R. P. S. Exhibition does not confine itself to pictorial photography, but covers many fields of photographic work, viz. Section I: Pictorial Prints. Section II: Pictorial Lantern Slides, Pictorial Color Transparencies and Prints. Section III: Natural History Subjects, Photomicrographs, Radiographs, Astronomical, Aerial and Spectrum Photographs, Stereoscopic Photography, Scientific Color Work and Technical Applications of Photography. With so wide a range it is obvious that the R. P. S. Exhibition was full and varied in interest.

The total number of exhibits accepted by the judges

of the various sections was close upon one thousand. Despite the fact that an American photographer, Pirie MacDonald, was this year invited to join the Judging Committee of the Pictorial Section, only 12 prints by American pictorialists found place among the 154 prints hung in this section. Of these, four were examples of portraiture by Mr. MacDonald, said by a prominent English professional to "represent the very finest work which has ever been done with the camera." About one third of this Section was given up to portraiture, the remainder being landscapes, figure work and genre. Most of the exhibits were bromide or chloride of silver (development) prints, but there were a few bromoil transfers, multiple gums, carbro and platinotype prints.

The exhibits in the Natural History Section ranged from insects to elephants and giraffes. Dr. J. B. Pardoe, of Bound Brook, N. J. sent to this department an amazing variety of birds and "wee beasties," from snapping turtles to lapwings. The reports also speak of a series of photographs "showing the Black-bellied Tarantula Spider in her home and the life history of the Field Cricket . . . of extraordinary interest."

In the Technical Applications Section the Research Laboratory of the Eastman Kodak Company, Rochester, N. Y., the Carnegie Institution, the Smithsonian Institution and the Bureau of Standards, Washington, D. C. were well represented by the results of studies in photographic problems. Passport forgeries, panoramic photography and many other industrial uses of photography also found place in this Section.

The Color Print Section displayed about 26 prints by the Raydex, Raydex Ozobrome and three-color carbon methods. They are spoken of as interesting but not convincing. The color transparencies and color lantern slides were either Paget or Autochrome, the latter predominating. John G. Capstaff sent an exhibit of motion pictures in colors, by the Kodachrome process, which is described as very satisfying.

Rex B. Wilsey exhibited a number of radiographs illustrating the great usefulness of the Potter-Bucky diaphragm (a grid made up of parallel strips of lead

foil, placed between the patient and the film) in preventing scatter radiation from reaching the film, and thus ensuring better definition, detail and contrast. Other interesting radiographs were shown by N. E. Luboshez, made on Eastman Dupli-Tized Film and clearly showing the advance in practice made possible by this wonderful film product.

Perhaps the most interesting individual exhibit in any section was that sent by J. Dudley Johnston, an English amateur, to the lantern slides section. This consisted of a set of 30 slides illustrating the factors governing color in lantern slides when using a developer containing a solvent of silver halide, and a second set of 30 slides showing the influence of thiocarbamide in the developer on the color of lantern slides. Accompanying the exhibit were detailed explanations of the processes used, so that the observer could visualize the procedure employed and the results obtained by the various modifications suggested.

The British Professional Photographers' Congress, held in London during September, included an international exhibition of professional portraiture which calls for notice here as, by general consent, the best portrait show the world has yet seen.

American photographers sent a large collection of prints, representative of the average professional work of this country rather than of its best achievements in portraiture. Perhaps this was a mistake as, in comparison with the more carefully selected work sent from European countries and the splendid showing of British portraiture, the American work was somewhat disappointing—despite which two medals were awarded in this section. From Scandinavian countries the work of Dr. Henry B. Goodwin, Ferdinand Flodin and Peter Elfelt headed a collection notable for superb technical quality. From Paris Benjamin, Manuel, Reutlinger, Melcy, Apers, and Nadar contributed portraits remarkable for vivacity and variety in pose and treatment. Scheim, of Vienna, and Perscheid, of Berlin, Socci, (of Alinari Bros.) Florence, Bettini and Bonaventure,

of Rome, and Sommariva, of Milan, sent of their very best; the British section, containing over 250 prints, was spoken of as the "finest collection of professional portraiture ever brought together," including the work of Speaight, Mr. and Mrs. Park, Scott, Basil, Banfield, Lambert, Lafayette, Hana and many other prominent studios.

The exhibit of Emilio Sommariva, of Milan, who had 30 prints accepted out of 90 submitted to the judges, was generally conceded to be "the biggest thing in the show," and was awarded a special medal as a group, the other awards being given to single prints. His portraits were characterized by their exquisite technique and artistic quality, exhibiting a richness of effect and delicacy of handling which delighted all who saw them.

The surprise of the exhibition was the award of the principal medal in the British Section to Mesdames Morter, two hitherto unknown English ladies whose work at the Salon, the R. P. S. Exhibition and in the £3000 Prize Competition recently held in England, has brought them into the very front rank with portraitists of long standing reputation. The prize picture was entitled "The Master of the Hounds," a portrait of a young woman in hunting costume, done in the manner of Romney.

The report of the Congress and the exhibition, together with its inspiring addresses by A. Swan Watson (President of P. P. A.), Herbert Lambert, Pirie MacDonald of New York, who attended the Congress as special representative of the Photographers Association of America, Charles Aylett, of Toronto, representing the photographers of Canada, C. P. Crowther, Marcus Adams and others, may be seen in *The British Journal of Photography* for September 15th and 22nd, which no American photographer should miss.

Quite as pictorial as anything in the Exhibition itself was the speech made by MacDonald before the Congress. It is too long for republication here, but briefly the speaker was inspired by the ovation with which the British photographers greeted him, and gave his fellow workers a talk which will go down into history as one of the best things MacDonald has done.

Those who know MacDonald can imagine how it went. Not a word of the "Old Man—Farewell Speech" stuff he gave us at the Buffalo Convention last year, but new-minted gold, bearing the image and superscription of the American eagle.

The Pictures of Hamilton Revelle were shown during October by the Department of Photography of the Brooklyn Institute of Arts and Sciences; landscapes, streets and old world byways, with a few good portraits. They were greatly admired—as was right and just. Revelle's output is not large, but few can approach him in nicety of technique in the handling of bromoil transfers or his skill in composition, which latter means to him, I think, knowing what to leave out. His work shows him to be a man of feeling and discrimination; he presents his subjects very simply and with restraint, by tone masses rather than by detail. In his outdoor pictures one senses the spirit of place, the atmosphere naturally belonging to the scene; in his portraits one is made aware of a degree of intimacy which is altogether pleasing and satisfying.

The Pictorial Photographers of America held their 52nd stated meeting at the Art Center, New York, November 6th, under the leadership of Clarence H. White, with Mrs. Gertrude Kasebier and Miss Christina Merriman as guests of honour. An exhibition of prints by Mrs. Kasebier occupied the walls of the meeting room, rich in pictorial and historical interest. It is many years now since I ventured the opinion that Mrs. Kasebier easily ranked first among the women portraitists of America and this exhibition moves me unhesitatingly to confirm that old word of praise.

Pittsburgh Salon 1923. The tenth annual exhibition of the Pittsburgh Salon of Photography will be held at the galleries of the Carnegie Institute, Pittsburgh, March 2 to 31, 1923. The latest date for entries is

February 5. Entry forms and particulars for intending exhibitors can be obtained from Charles K. Archer, 1412 Carnegie Building, Pittsburgh, Penn.

The Columbia Photographic Society is a progressive Philadelphia organization which owns its own club building at 4605 Germantown Avenue, has an unusually complete library and working equipment for every branch of photography and offers an attractive programme of activities for the season.

The Elysian Camera Club, of Hoboken, N. J. held an exhibition of pictorial photographs and portraits by Charles Henry Davis, of New York, during November. The collection included many of the pictures shown by Mr. Davis at recent Salons, the Royal exhibitions and other one-man shows, and drew a large attendance.

Misonne's Landscapes. The November one-man exhibition of the New York Camera Club comprised fifty examples of the work of Leonard Misonne, Belgium's foremost pictorialist. All the prints were of uniform size, 11 x 14 inches, and were produced by the oil process, of which Misonne is an acknowledged master.

It is difficult to speak of Misonne's work without indulging in extravagant praise. He is an artist using photography as a means of expression, and his pictures give one so completely to see what he saw that the method or process by which they were made does not come in at all. His subjects are largely pastoral in character; country roads, fields and hedgerows, a farmyard with a figure or two, river scenes, landscapes and marshes in Autum or Winter; sometimes touched with the magic of sunrise, at other times half hidden, half revealed in the fading light and mystery of a late afternoon in October. In this—one marvels at the lightness of touch and delicacy of handling of the tone gradations, in that—the eye is delighted by the colorful

force and vigor with which an approaching storm is portrayed; always the light effects are fascinating, whether in the subtleties of sunlight falling through a veil of foliage or gilding the leafy tips of foreground masses. Perhaps there was a suspicion of too much sweetness, of overmuch sheer beauty. Despite the variety in subjects to have seen one was to have seen all. But, all in all, it was perhaps the most inspiring of the European collections which Mr. Floyd Vail has thus far brought to the New York Camera Club.

The October exhibition offered a careful selection of about eighty prints by European pictorialists, from the permanent collection of the Smithsonian Institution and U. S. National Museum, Washington, D. C. A list of the exhibitors will suffice to show the character and interest of the display, viz: J. Craig Annan (Scotland), Malcolm Arbuthnot, Angus Basil, Charles Borup, Sr. Brigden, Fred Judge, Alexander Keighley, Kate Smith and Louis J. Steele (England), J. Arthur Lomax (Wales) Leonard Misonne (Belgium), Guido Rey (Italy), Richard Polak (Holland), and J. H. Coatsworth (Egypt).

The September exhibition was, as usual, made up of pictures by the members of the club, and brought together an extremely varied and interesting display. I can mention only two or three exhibits of a score or more deserving praise: J. H. McKinley sent a spirited portrait of Stefansson, the explorer; Paul Strand, two clever examples of design composition; Dr. Theron W. Kilmer sent a few multiple gum prints of unusual quality; Nickolas Muray was represented by half a dozen figure studies which attracted much admiration; and Eugene Vail contributed portraits of Moses Joy and Esta Varez, revealing a keen appreciation of the widely different personalities of his subjects and skill in their interpretation.

In Memoriam

OSBORNE I. YELLOTT

Despite the passing of many days, it is fitting that these pages should carry a word of loving tribute to the memory of Osborne I. Yellott, of Baltimore, who met his death by tragic misadventure in an automobile accident in that city last March.

The older readers of The Photo-Miniature, who witnessed the stormy birth of the pictorial movement in American photography, will recall Mr. Yellott as an enthusiastic amateur and exhibitor who led the opposition against the excesses and destructive tendencies of that movement in its earliest activities. The fine spirit and lovable personality evident in his work at that time, his brilliance in debate, the ready flow of wit and reason in his many contributions to the press and as a judge at the prominent exhibitions of the day, brought him a host of friends in photography by whom his passing will be regarded as a personal loss.

Among the very first to recognize the high purpose and usefulness of The Photo-Miniature, he contributed three monographs to the early volumes of the Series and, amid the distractions of a crowded life, kept his interest in the work of the magazine to the last.

Coming from a family of notable Maryland jurists, and himself a lawyer of outstanding ability, Mr. Yellott's life was largely devoted to the protection of the public interests in legal, civic and state affairs, in which his success was recognized by his appointment to serve "for the People" on many Public Commissions and in prominent legal controversies. He was a man of many gifts and an untiring worker, widely read in science and history and a keen motorist. In this last capacity he gave yeoman service to the cause of good roads and the furtherance of traffic and transportation legislation in his State.

The immense gathering of State officials, professional associates, citizens and friends at his burial bore eloquent testimony to the sorrow of the community in its loss.

Notes and Comment

Pinhole Exposures. In an article on this topic in the November issue of *American Photography*, Bertrand H. Wentworth questions the accuracy of the Powers rule for pinhole exposures given in THE PHOTO-MINIATURE: No. 70, as well as the systems of Mallory and Watkins which were based on the Powers rule. As the result of his experiments he gives the following diameters for a series of pinhole apertures, in millimeters:

1.25	0.884	0.625	0.442	0.313

These diameters are the very approximate quotients of 1 centimeter divided, respectively, by:

8	11.3137	16	22.6274	32

These divisors are, of course, the accurate F: numbers usually marked on lenses and meters as

F:8	F:11	F:16	F:22	F:32

It will be seen that this series of diameters gives the true F: values for a theoretical unit focal length of 1 centimeter and they are so marked.

To use the system, read the exposure for the chosen pinhole on any exposure table, measure the extension of the camera for the subject to be photographed in centimeters, and multiply the stop chosen by the square of the extension, in centimeters, which will give the required exposure in minutes.

Milner's Light Gauge, the smallest and most convenient device for measuring the strength of light in exposure with which I am acquainted, is now available for overseas readers, being stocked by J. Lizars, of Liverpool, England, and many branch houses. The price of the Gauge has been reduced from $1.50 to $1.

Photographs in Colors. For some years past I have been keenly interested in the color research work of Henrietta Hudson, whose laboratory is at Bolton Landing on Lake George, Warren County, N. Y. A practical

outcome of this research work is an ingenious but simple method for producing photographic prints in colors from a direct color negative, outlined in U. S. Patent No. 1,431,663, dated October 10, 1922. The color prints made by this method which I have seen are remarkable in many respects. It is to be hoped that facilities for the practical use of the method will soon be available.

Muybridge Slides. The name and work of Eduard Muybridge are seldom recalled today. Yet Muybridge, using the wet collodion process at Palo Alto, California, between the years 1872–77, was, with Marey of France, among the first to apply photography to the analysis of movement, and the motion picture of today is largely based upon his pioneer work in that field. Mr. Moses Joy, of the New York Camera Club, has in his possession about a hundred lantern slides made from Muybridge's early motion-study negatives and seeks a purchaser for his collection. It is unique in historical interest and should find a place in a public museum.

The O. D. D. Mr. Alfred Freeman, the inventor of the Freeman Optical Divergence Determiner for cameras, called while in New York a few weeks ago and showed me some very convincing proofs of the unique usefulness of this little device, which adds so largely to the efficiency of the hand camera. What it is, how it works and what it does are clearly explained and illustrated in the O. D. D. booklet, which can be had for the asking from the Freeman Pictorial Photograph Mfg. Co., Colorado Springs, Colo., if your dealer does not carry the O. D. D. in stock.

Three-Color Transparencies, made by superimposing three dyed or color positives from a color separation set of negatives, are easily produced by the method and formulas given in the November issue of *The Club Photographer* by Frederic G. Tutton, who was

awarded the R. P. S. medal (1922) for his work in this specialty.

Topographic Surveys. A simple and efficient method of aerial and terrestrial stereophotographic surveying is made possible by the introduction of the Stereoautograph by the Carl Zeiss works at Jena, which is employed by many European governments as well as our own U. S. Geological Survey Department at Washington. The apparatus used in this method, which effectually displaces all methods hitherto employed in survey work, may be seen at the offices of Harold M. Bennett, Agent for Carl Zeiss, New York, from whom an illustrated, descriptive booklet may be obtained.

Aerial Photography. The New York newspapers have published during the past year many aerial maps or views of the metropolis and nearby cities, made by the Fairchild Aerial Camera Co. with a new aerial camera perfected by Mr. Sherman M. Fairchild. One of the most remarkable of these maps was a complete aerial survey of the whole of New York City, from the Battery to the City boundaries near Yonkers, published in three rotogravure sections by the "N. Y. Evening Post," showing every street, dock, prominent building and monument in clear detail. This map was a mosaic of one hundred aerial photographs made at an altitude of 10,000 feet in a single flight of 69 minutes, fitted together like a picture puzzle to form a print 8 feet long by 20 inches wide.

Autotype Trichrome Tissues. The making of photographs in color, by means of three color-separation negatives and superimposed prints from these made on carbon tissues, seems to be interesting many amateurs. A special leaflet describing the method, and the trichrome carbon tissues required, can be obtained on request from the American Agent, George Murphy, Inc., New York.

The Prize Competitions announced by John G. Marshall, 1751 Atlantic Avenue, Brooklyn, N. Y., should not be overlooked by our readers. The purpose of these competitions is to obtain photographs useful for advertising the Marshall Meteor Flashlight, Oil Colors, and photographic chemicals, one prize of $50 cash being offered each month.

Cooke Anastigmats. The 1922 catalogue of these well-known English lenses, just issued by the American distributors Burke & James, Inc., Chicago and New York, provides, in addition to a very complete descriptive list of the several series of Cooke anastigmats available for various uses, a collection of short papers on applied photographic optics offering much practical lens information to amateur and professional photographers. Copies of the list will be sent free on request by Messrs. Burke & James to anyone mentioning this note.

Scales for Finding Metric Equivalents and Mensuration Results, instantly and without calculation, indispensable to readers of scientific and technical literature, and very conveniently condensed within the limits of a card measuring only 4 x 5 inches folded, may be obtained from A. E. Bawtree, 7 Manor Road, Sutton, Surrey, England, for the nominal sum of thirty cents.

The 1922 Kodak Catalogue introduces a new model, No. 1 Pocket Kodak, Series II, which is bound to become popular with beginners. It is thinner and lighter than the earlier No. 1, giving the same size picture 2¼ x 3¼, has a self-erecting front so that the lens springs into fixed-focus position as soon as the camera is opened, is fitted with the Autographic feature and an exposure shutter giving exposures of 1–25, 1–50 and 1–100 second, with "time" and "bulb." A remarkable camera for its price $13.50.

The Eastman Projection Printer tempts one to in-

dulge in slang. I fall. It is "a corker for speed." Thus an English trade enlarger writes to Kodak Ltd. under date September 8: "We have made 25,000 enlargements this year, and all have been made by one young lady *alone* with the Projection Printer we bought last February." A later note says that the "young lady alone" not only made the exposures but also developed the enlargements. On the basis of 184 eight-hour days between February 8 and September 7 this works out as one enlargement every 3½ minutes. Apparently this fortunate enlarger has a faster worker in reserve, for he adds: "We expect to do 3000 a week up to Christmas, so must have another Projection Printer." Which figures out as one enlargement per minute from the two Printers and their attendant divinities. To top which I am told, on reliable authority, that at Rochester a skilled operator of the Projection Printer, "working on a straight run," can turn out 1400 enlargements per diem; or 3 enlargements per minute. Those "slow Britishers!"

Neol. The unusual claims made for this latest Hauff developer (G. Gennert, New York, American Agent) are generally sustained by reports from practical experience. Thus Neol permits of the widest latitude in exposure and equalizes great contrasts in the lighting of the subject, as in photographing difficult interiors including brilliantly lighted windows. It also minimizes or eliminates halation and irradiation effects, being invaluable to commercial photographers in photographing highly glazed objects, china and glassware, statuary, etc., keeping the details of the highlights even when photographing against the light. Apart from these uses in negative making Neol gives pleasing sepia tones on gaslight papers by direct development.

Distar Lenses. Readers who possess Carl Zeiss F:4.5 and F: 6.3 lenses and double extension hand cameras should send to Harold M. Bennett, 153 West 23rd Street, New York, for the Distar Lens Booklet, which

shows how the addition of the Distar gives to these anastigmats the wide range of uses of a set of convertible lenses. The booklet is interestingly written and its fine illustrations clearly demonstrate the many-sided usefulness of the Distars.

The Dorotype, a revival of the old collodion transparency with a tinted backing, was an interesting feature of the Hammer Dry Plate Company's display at Willoughby's last week. Of course, the Dorotype is made on a gelatine dry plate, the method being given in the new edition of Hammer's Little Book, obtainable on request from the Hammer Dry Plate Co., Saint Louis, Mo. Apart from its use as a specialty in portraiture, the Dorotype is being widely employed in advertising, e. g. a furrier recently ordered two thousand 11 x 14 Dorotypes of attractively attired girl models to illustrate the beauty of his furs.

Albums and Calendars. The Photo-Miniature is a strong advocate of the album habit for all workers in photography, as the best and most satisfying method of keeping a record of one's work with the camera. Loose prints are easily lost, strayed or stolen, can rarely be found when wanted and, when found, are generally damaged in some way. Form the habit of putting a good print from every negative into an album, with a title and date under every print; you will get a lifetime of satisfaction from the record and your children will rise up and call you blessed. Send today to The Housh Company, 7 East Concord St., Boston, Mass., mentioning The Photo-Miniature, and ask for a copy of the 1922 illustrated catalogue of albums and calendars.

The N. Y. Institute of Photography has opened its third school for the teaching of practical photography and motion picture operation at 630 South Wabash Avenue, Chicago. The Reports from students of the

Institute express satisfaction with the various courses offered and the roll of students grows steadily larger.

R. J. Fitzsimons, Inc. Since the death of Mr. Robert Fitzsimons about a year ago, the flourishing business he established has been incorporated under the personal management of Mrs. Fitzsimons, who has made the Fitzsimons shop at 75 Fifth Avenue (near 15th Street) one of the most interesting of New York's many photographic stores. The firm, as is well known, is American headquarters for Autochrome plates and the other thousand and one products of the Lumiere-Jougla concern, of France; the long line of stereoscopic cameras and accessories of Jules Richard, of Paris; the Ilford Panchromatic plates and color filters, Den sensitol, etc.; the Griffin Development Tanks and other European specialties of high repute.

Dallmeyer Lenses. The American agency for these lenses is now in the hands of Herbert and Huesgen Co., 18 East 42nd Street, New York, from whom the new catalogue can be obtained on request. Readers who have The Photo-Miniature No. 184: Soft Focus Effects on their bookshelf should note that the Dallmeyer Pentac Anastigmat, F: 2.0 is available with a diffusing mount, which adds to the usefulness of this lens for portraiture when focal lengths of 8 inches or more are employed.

Contessa-Nettel Cameras in no less than forty models are described and illustrated in the 1922 catalogue received from the American Agent: G. Gennert, New York. Looking over this remarkable display, it would seem that hand camera construction is nearing finality as far as compactness, workmanship and convenience of use are concerned. Especially noteworthy is the variety of cameras intended for use with plates or film packs, double-extension capacity, rising, falling and cross front movements and rack and pinion focusing de-

vice. Other interesting booklets received, which, with the Contessa-Nettel camera catalogue, may be had from G. Gennert on request, are: the Hauff Neol Developer booklet; the Piccolette Book; an illustrated guide to the use of Hauff Dry Plates, and the instruction book for Imperial Matchless Paper, a new print-out paper which has no gelatine or collodion film, gives its image on the paper (similar to platinum), and may be used as a self-toning paper or rinsed, toned and fixed like other print-out papers.

Photo-Sculpture. A new method of sculpture in which photography plays an important part is described in a 36-page pamphlet received from the inventor, W. F. Engelmann, a mechanical engineer, of Chicago.

As described, the method consists of two operations. First, the recording of the form of the object by taking a series of contour pictures of the object with a motion picture camera. Second, the carving out of the reproduction, a simple milling operation, in which the reproduction is milled out in as many planes as there were contour pictures made of the object.

The advantages of the method are summarized as follows. (1) The presence of the model (subject) is required only for the few minutes necessary for the motion picture recording. (2) The reproductions are absolute likenesses of the originals. (3) Reproductions can be made in any material and in any size, e. g. life-size for monuments or miniature size for jewelry designs. (4) The method calls for little training or skill in the operator. (5) A reproduction can be made within a few hours and at a small cost.

The invention is one which interests professional photographers, sculptors and art workers generally, opening up, as it does, a wide field of usefulness.

Ansco Amateur Cameras are interestingly described and illustrated in a folder recently issued by Ansco Company, Binghamton, N. Y. The Ansco line is remarkably varied in its completeness, and includes

models adapted to every amateur need and purse, from the modest Buster Brown fixed-focus box in four sizes priced under five dollars to the de luxe Ansco Speedex in three sizes at forty-five dollars, fitted with an optical equipment meeting the most exacting requirements.

Agfa Products. Despite the many difficulties attending the importation of European photographic goods, the Sagamore Chemical Co., 215 Water Street, New York, reports that an increasing volume of Agfa plates and X-ray films, developers, color filters, flashlight and flashlamps is reaching this country, and that all dealers can supply these well-known specialties. Where local dealers cannot supply, orders addressed direct to the Agents as above will receive prompt attention.

The Technical Photographic and Microscopical Society, recently organized at New York, held its first general meeting and exhibition in connection with the National Chemical Exposition at New York during September. The exhibition comprised several hundreds of industrial, microscopical and aerial photographs, with special apparatus of various kinds; the lectures were illustrated by motion pictures and were largely attended. The chairman of the committee on photography is J. A. Lucas, who may be addressed at the office of the Society, Room 710, 36 West 44th Street, New York City.

At the December meeting of the Society, to be held at the Chemists' Club, 52 East 41st Street, New York, on December 15, Dr. F. F. Renwick, Dr. A. B. Hitchins and Dr. Herbert E. Ives will read papers dealing with the uses of photography and motion pictures in industry, chemical aspects of photographic science, and color measurement as utilized in color photography.

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Making an Automatic Focusing Enlarger

The making of large prints from small negatives is undoubtedly the most interesting problem in photography today. It is, in fact, today's preparation for the photography of tomorrow, when compact cameras of the Cine Kodak, Ica Kinamo and Sept type, instantly adjustable for rapid motion or individual exposures, will replace the existing hand and pocket cameras, and all our negatives will be small negatives—no bigger than a man's thumb-nail. Coming events cast their shadows before. For almost every serious purpose we need prints at least 5 x 7 to 8 x 10 inches in size: e. g. for portfolio, illustration, process reproduction, record and exhibition use. Until recently we have used cameras and equipment producing negatives of the size required in the print, obtaining the print by the method familiarly known as contact printing. But the world-wide demonstration, on the motion picture screen, that large prints of superb quality can be obtained from negatives no larger than 1 x 3/4 inch, has done its work. As one result seventy-five per cent of the negatives made by amateurs today are made with the perfected miniature or pocket camera, giving negatives generally smaller than 2 1/4 x 3 1/4 inches. Similarly, among professional and commercial photographers the tendency grows, of making small negatives and deliver-

ing prints therefrom as large as their intended use demands. Thus we have come to see that it is no longer necessary to make a negative as large as the print desired, since the quality of the print depends wholly on the quality of the negative and not on its size, or on the method employed in making the print. Hence the vital interest and significance of the methods available for the making of large prints from small negatives, commonly spoken of as enlarging methods.

Old and New. These methods have been discussed at length in many issues of THE PHOTO-MINIATURE: e. g. Nos. 16, 35, 75, 100, 144 and 164, all now out of print. They served their day and purpose by showing how to get large prints from small negatives by projection printing (enlarging), fully equal in quality to the large prints obtained directly from large negatives by contact printing. That these enlarging methods were more troublesome than the making of contact prints was indisputable, but the convenience of the small negative and the possibilities of modification and control in the enlarging process more than compensated for the disadvantages. Within the past year or two, however, enlarging methods have been, so to say, revolutionized by the introduction of special apparatus by which the bothers and difficulties peculiar to the earlier methods have been completely eliminated, and the making of large prints from small negatives (enlargements) is as simple as the making of contact prints.

The Heart of the Difficulty in the oldtime methods was the obtaining of a sharply defined image of the size or degree of enlargement desired. This depended, and still depends, upon a certain and accurate adjustment of the relative positions of the lens of the enlarging apparatus and the negative, and of the lens and the easel or sensitive paper on which the enlargement is obtained—an optical problem, solved by the use of lens calculations or by tedious trial and error. What happens is that with every change in the size or degree of enlargement desired, the pair of distances of the negative and of the sensitive paper respectively from the lens must be altered according to a definite rule

governing their relation. Enlarging, reduced to its simplest terms, is based upon placing the lens between the easel and negative at certain definite positions with respect to the positions occupied by the easel and negative to secure different degrees of enlargement in the projected image. When, by repeated and bothersome adjustment this correct relation of the distances separating lens and easel and lens and negative is secured, then we get a sharply defined image of the size desired. With the automatic enlarging apparatus of today this adjustment is obtained by a simple movement of one part of the apparatus, by which the projected image is made to grow or shrink at will and yet is always maintained in perfect focus or definition. This means the elimination of all the trouble and fussing encountered in the earlier enlarging methods, together with complete control of the elements or composition of the enlarged image. The device by which this simplification of enlarging is effected consists essentially of a cam mechanism which so coordinates the movement of the parts of the apparatus as to automatically produce the relation of lens distances ensuring a sharply defined image at any desired degree of enlargement within the capacity of the apparatus in use.

Automatic Enlargers. The credit for the introduction of this improvement is due to the Eastman Kodak Company, and as the first commercial examples of this type of enlarger we have the Kodak Auto Focus Enlarger and Projection Printers, now coming into general use. Other examples are the Rexo Automatic Enlarger (Burke & James) and the Forsberg, with one or two European models not obtainable here. In the following pages Mr. Chester A. Kotterman describes and illustrates the design and construction of such an automatic enlarger. The special apparatus he describes may be made to serve a double purpose and so has a larger capacity than any of the commercial models. In the first form, as set forth in detail, it is a self-contained automatic focusing enlarger for prints up to 8 x 10 inches, Fig. C, and may be used in any room illuminated with daylight or artificial light, a con-

venience to the amateur who has no darkroom. In the second form suggested, the enlarger may be converted, by certain adjustment of its parts, into a projection printer, as shown in Figs. D and Q, where Fig. D gives a side view and Fig. Q an end view, giving enlargements larger than 8 x 10 inches. In this form, however, it is no longer a self-contained unit, but is used with a separate and independent easel and requires a dark-room or enlarging room for its operation. In either form the lens employed in making the original negative is used in making the enlargement.

Note, in passing, that in speaking of degree or times of enlargement in these pages, the reference is always to linear dimensions, not to increases of area. Thus a 4-times enlargement of a negative 2¼ x 3¼ inches gives an enlargement 9 x 13 inches.

Enlarging Fundamentals. As enlarging is simply an application of certain well-known optical laws or principles, it will be well at this point to consider briefly two fundamentals in enlarging, so that the principles underlying the designing and construction of an enlarger will be clear to the reader.

Focal Length. In the development of the cam mechanism which is the vital factor in an automatic focusing enlarger, it is essential to know, very precisely, the equivalent focal length of the lens to be used as part of the apparatus. With the design for an enlarger given in this issue, full-size diagrams (Fig. T) are provided for the construction of two cams calculated for use with miniature camera lenses of 3″ and 3½″ equiv. focus respectively. But it will not do for the reader to assume that the lens on his camera, listed as 3″ or 3½″, will work with the 3″ or 3½″ cam shown in the diagram. This will not be the case unless the equiv. focus of the reader's lens is exactly the same as the equiv. focus of the 3″ or 3½″ lenses mentioned in the text. The focal lengths of lenses listed in manufacturers' catalogues are approximate only; on careful measurement the actual equiv. focus of almost any one will slightly differ from the approximate figure used to classify the lens in the makers' list. In ordinary photographic work this slight difference need not be consid-

ered, but it is of prime importance in the development of the cam required in the automatic enlarger. Hence the first thing to know is the actual equiv. focus of the lens to be used in the enlarger. If it is not exactly the same as the 3″ or 3½″ lens mentioned in the text, the reader must develop a cam fitted to his lens, following as a guide the method of laying out a cam described on other pages.

Finding Equivalent Focus. The simplest way of finding the actual equiv. focus of the lens on your camera is to write to the maker, giving the number of the lens and asking for the precise information desired. Or any lens or camera repairer, possessing an optical bench or long bellows camera, can by a careful test of the lens supply the exact focal length in millimeters. Or you can find it for yourself by the following method, due to the late T. R. Dallmeyer. Remove the back from the camera and set up a groundglass or focusing screen at right angles to the optical axis of the lens. Focus on some very distant object as a cloud or prominent object in a distant view. Measure from the image side of the groundglass along the optical axis of the lens to any convenient point on the lens mounting, calling this distance a. The point of intersection of the focal plane with the optical axis of the lens is known as the back focal point designated F. Now reverse the lens in its mounting, or reverse the position of the camera, retaining the relative position of the lens, camera and screen. Focus on the same distant object and measure similarly the distance b from the image to any convenient point on the lens mounting. This locates the front focal point F^1. Next focus on an object three or four estimated focal lengths away. Measure the distance from the object to the point on the lens mounting used for b, designating this measurement as c; likewise the distance from the object to the other point a, designating this distance d. Let f be the equivalent focus of the lens. Then $f^2 = (c - b)\ (d - a)$ and by substituting the distances measured for a, b, c, and d in this equation it becomes an easy matter to arrive at the value of f, which is the exact equiv. focus of the lens used. This method, while not as simple as some others in the books,

is an exact method; and errors in determining the various distances least affect the result when the image and object are of equal size, that is, when the distances *c* and *d* are equal. It is a good plan to repeat these measurements several times, obtaining an average value of f. With this knowledge of the exact equiv. focus of the lens on your camera the development of the cam for the enlarger may be carried out with complete confidence as to results.

Conjugate Foci and Enlarging. The other fundamental is a knowledge of the law of conjugate foci as applied in enlarging. The word foci is the plural form of focus and conjugate foci simply means a pair of foci joined together or related. The conjugate foci used in enlarging are the distances of the negative and sensitive paper respectively from the lens. These distances depend on the focal length of the lens and change with each different degree of enlargement. Their actual length is determined by the focal length of the lens; their relative length by the degree of enlargement, following a definite rule.

In making a copy of the same size as the original the two conjugate foci are exactly the same and each one is twice the focal length of the lens. This establishes an important rule in photographic optics, viz., that the distance separating an object and a fullsize image of that object is equal to four times the focal length of the lens used. When we make an enlarged image of an object, the conjugates differ according to the degree of enlargement, but according to the following rule. The distance between the sensitive paper or easel and the lens equals the focal length of the lens *multiplied* by the degree of enlargement plus one focal length, and this distance is known as the major conjugate. Thus with a 3″ lens and 2-times enlargement it is $3 \times 2 + 3 = 9$ inches. The distance of the negative from the lens equals the focal length of the lens *divided* by the degree of enlargement plus one focal length, and this distance is known as the minor conjugate. Thus $3 \div 2 + 3 = 4\frac{1}{2}$ inches. With these simple rules one may calculate the conjugate foci or lens distances required for any desired degree of enlargement and, in the oldtime meth-

ods of enlarging, either this was done or one made use of the convenient Table of Conjugates for Enlarging to be found in any photographic yearbook. When these various combinations of major and minor conjugates or lens distances are brought about simultaneously by some mechanical means we have automatic focus enlarging. This is effected in the apparatus which, from this point forward, is described by Mr. Kotterman. EDITOR.

Hypothetical Enlarger. Before considering in detail the actual design and construction of an automatic focusing enlarger, let us formulate a hypothetical device so as to lay down the fundamental factors to be considered in an apparatus of this character.

Suppose we mount an easel at one end of a base or platform. On top of this base let us place a smaller base free to slide back and forth between guide rails on the supporting base. If we mount the miniature camera, whose lens we are going to use as the enlarging lens, on this auxiliary base, we may alter the distance between the easel and the lens by sliding the auxiliary base on the main base. If now we could move the negative holder with respect to the lens while racking in and out the lens with respect to the easel, the whole problem of automatic focusing for any degree of enlargement would be solved.

Let us now refer to the illustrations running with the text for the better visualization of such an enlarger. In the references which follow, the specific part or detail of the apparatus spoken of is designated by a numeral within brackets, the illustration or diagram to be consulted being designated as Fig. A, B, C, or other letter of the alphabet. Every detail or specific part of the apparatus always carries the same numeral, but sometimes the reference is made to this detail in several diagrams. Note that Fig. T will be found on the folded insert facing first page of the text, while Fig. S is given on the first page of this insert. All other Figs. are given in the text pages.

The Hypothetical Apparatus Visualized. Fig. A is the main base of the apparatus supporting at the left

end an adjustable easel, or in this case an enlarging back (8) Fig. B, for the sensitized material; sliding on top of the main base is another and smaller base (14) Fig. B carrying a fixed lens bracket (15) Fig. B; and a superposed negative holder (17) Fig. B capable of moving relatively to the main base and the auxiliary base.

Suppose we attach a long toothed rack (4) Fig. A, to one of the guide rails which fix the path of travel of the auxiliary base, and suppose further we have attached to the auxiliary base a rotating axle on which is a small

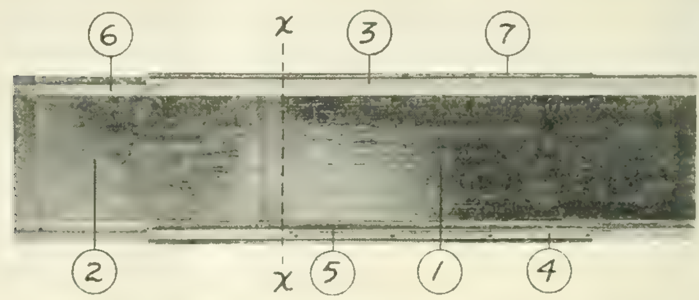

Fig. A

gear wheel engaging with the teeth in the rack. By means of this rack and pinion, similar to those employed on view cameras, the auxiliary base is made to move forward and backward on the main base. If we attach a bevel toothed wheel to the rotating axle and mount an upright spindle carrying a similar bevel toothed wheel on the auxiliary base, a rotary motion will be imparted to the bevel gear on the spindle at the same time the auxiliary base is sliding on the main base. If we then attach a cam shaped disc of metal to the bevel gear on the vertical spindle, the edge of which presses against a stud fixed to the negative carrier, the latter will move with reference to the lens while the lens is moving with respect to the easel, and the shape or contour of the cam, pressing against the stud, determines the degree of movement of the negative holder; and the coordination of the several movements will

determine the degree of magnification of the negative image. This in substance is what is done with the enlarger here described.

Nomenclature. The automatic enlarging apparatus here described consists of the following essential parts:

1. The main base or support for the apparatus. Figs. A and B.
2. The enlarging back, carrying the focusing screen, bromide paper holder or plate holder and the roller ends of the bellows. (8) Fig. B.

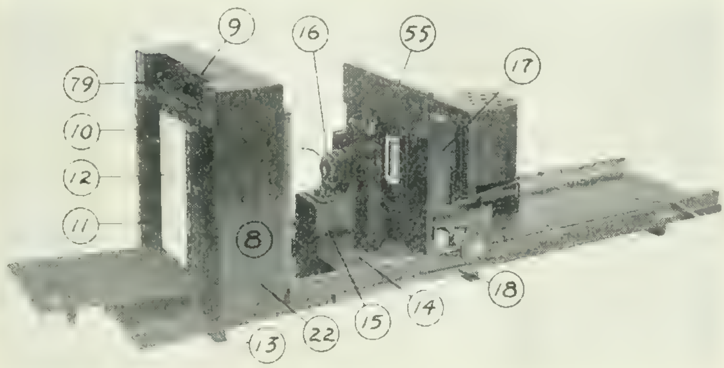

Fig. B

3. The auxiliary base (14) Figs. B and F, which supports—
   a. The cam mechanism producing automatic focusing, Fig. G.
   b. The lens and camera bracket. (Chair device (15) Figs. B and L.)
   c. The negative and condenser carrier, (17) Fig. K and (65) Fig. L.
   d. The lamp house or illuminator, (57) Fig. K.

The Main Base, Figs. A and S (which is a cross-sectional view of the apparatus, half full-size, looking towards the easel end) consists of two wooden sections (1) and (2) hinged on the line x—x. (2) the shorter section is 20¼″ long and (1) the longer section is 31″; and their width is 12⅜″. Each section is made of four

strips of poplar wood ⅞″ thick glued together and fitted with tongue and grooved batons at the ends, with three cleats (13) Fig. B, underneath to prevent warping. The base is held in a continuous flat surface by means of the brass strips (18) Fig. B. These brass strips have another function which will be explained later. The guide rails (3) Figs. A and S extend nearly the entire length of each edge of the main base to fix the path of travel of the auxiliary base. They have the cross-section and dimensions shown in Fig. S. They are screwed, one on each side of the main base and parallel to its edges. Like the main base the guide rails are made in two sections with the joint at the same point as the hinged line of the main base. See Fig. A. The guide rails extend the entire length of the longer section (1), but they only extend 10″ from the dividing line on the shorter section.

Before these guides are permanently attached to the base, two grooves 3/16″ deep and ¾″ wide are cut in the main base adjacent each guide rail. These grooves, which reach the entire length of the main base, are then filled with hardwood strips of the same length as the guide rails and projecting above the surface of the base 1/16″, (5) Fig. A and (5) Fig. S. The raised surface of these strips eliminates nearly all sliding friction between the auxiliary and the main base. Of course, the guide rails and raised strips are integral with each section of the main base so that when this is flat they appear continuous. The guide rails and the inserts do not extend the full length of the shorter section of the base but leave an open part (6) Fig. A of the grooves at one end, as indicated. These grooves afford a means for attaching the enlarging back to the base in a slightly movable manner so it may be adjusted for critical focusing, as explained later.

The Enlarging Back (8) Figs. B, E and O consists of a main rectangular wooden frame, like a box without top or bottom, 4½″ depth, 15″ wide and 15 3/16″ high, made of ½″ poplar wood. The back edge of this rectangular box is fitted with a frame the opening of which corresponds to the opening of the bromide paper holder. The holder is an 8 x 10 Eastman combination

bromide paper and plate holder, or single book holder equipped with nesting kits from $3\frac{1}{4} \times 4\frac{1}{4}$ to 8 x 10. [The size of the plate holder determines the more important dimensions of the apparatus. That is, if an 11 x 14 holder were desired instead of the 8 x 10, as here described, then the optical axis of the lens, the center of the negative carriage and the center of the illuminator would have to be raised a greater distance from the surface of the main base than would be necessary when using the 8 x 10 holder.] The holder is illustrated in Fig. R. The top back edge of the frame is cut away as at (9) Fig. O to provide clearance for the fingers when inserting and removing the plate holder.

The plate holder is held against the framed opening of the back edge of the rectangular box by means of two strips of wood, one on each vertical edge of the frame, as indicated by (10) Figs. B and O. These L-shaped pieces of wood contain flat bowed springs (11) Fig. B which force the holder against the frame, and the opening between the inner surface of the strips and the back is such that when the focusing screen (12) Fig. B is in place the holder may be inserted between it and the back of the enlarging back, as is ordinarily done with view cameras.

The focusing screen (12) Fig. B is simply a thin wooden frame similar to a picture frame. It has a recess in which fits the sheet of ground glass and may or may not be fitted with a hinged back. The ground glass should be of a very fine grain which will permit of sharp focusing. Care must be taken to insure that both the focusing side of the ground glass and the sensitized surface of the enlarging material, when in place in the plate holder, register exactly in the same plane, otherwise the sharp image as seen on the ground glass may not be sharp when the plate holder is inserted.

Critical Focusing. The adjustment of the enlarging back to secure critical focusing is accomplished in the following manner. Two hardwood strips (72) Fig. O are screwed to the bottom surface of the rectangular frame. These strips are thick enough to project about $\frac{1}{16}''$ above the surface of the main base, which prevents

the bottom of the rectangular frame sliding directly upon the main base, thus reducing the friction between these to a minimum. The strips should be attached even with the front edge of the frame but may extend from the back edge about an inch to give greater stability and they should slide freely in the unfilled portions of the grooves of the main base. One end of the threaded axle (71) Figs. C and O, 3/8″ in diameter and 7″ long rotates in the brass plate (70) Fig. O which is screwed to the bottom edge of the frame. A small brass plate (19) Fig. C having a threaded hole through which

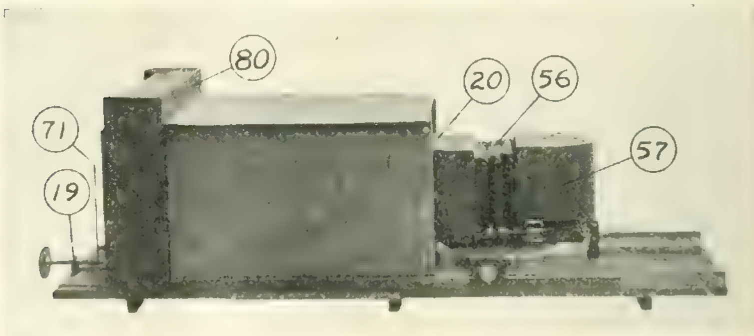

Fig. C

screws the axle (71) is attached to the end of the main base. A hand wheel is fastened firmly to this axle, and by turning it the enlarging back is moved very slowly back and forth in the grooves of the main base, thus affording a means for very sharp focusing.

For Diffusion Effects. A box-like frame (25) Fig. E constructed of 1/4″ wood with inside dimensions as shown in Fig. O is fitted within the main rectangular frame of the enlarging back. This frame is not necessary but may be found convenient if it should be desired to make diffused focus enlargements through bolting silk. Light wooden frames may be covered with the silk, and these frames fitted nicely on the inside of the box-like frame; thus they may be moved back and forth in this inner frame in front of the enlarging material and the adjustment possible provides most any degree of softness or diffusion of the projected image.

The Bellows. A study of Fig. E discloses the manner in which the parts of the bellows are assembled and attached to the enlarging back; and Fig. C shows the enlarging back complete with the bellows extended. The bellows consists of three opaque window shades rolling up on spring rollers attached to the sides and top of the enlarging back with the main base as the

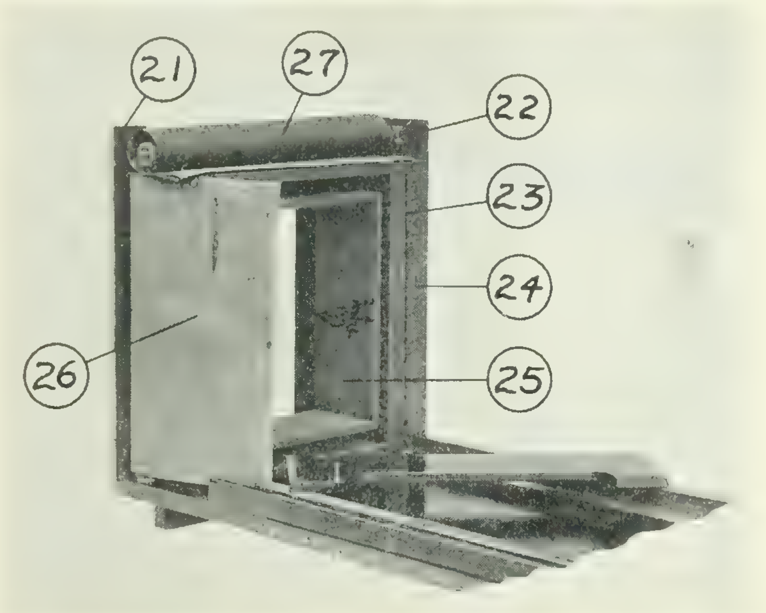

Fig. E

fourth side. The opaque window shade material, preferably of a dull black color, is 36″ long. The width of the two side curtains is 12″ and the top edges of these come even with the top surface of the rectangular frame of the enlarging back and the lower edges just reach the bottom of the grooves (78) Figs. Q and S formed by the guide rails and the extra pieces (7) Figs. A and S. The two side rollers are held in place by small brass strips (79) Fig. B screwed to the top and bottom cf the enlarging back extending far enough out so the hades will roll completely up without touching the sides of the frame.

Two strips of ½″ wood (21) Figs. E and O are next screwed even with the back edge of the enlarging back and even with the bottom, but projecting above the top of the frame with sufficient width that when two similar pieces (22) Figs. B and E are screwed at right-angles to the two pieces just mentioned they will clear the shade when it is rolled up. Fig. E shows one of these side pieces removed. Two more pieces of wood (24) Fig. E of the same height as the enlarging back are attached to the pieces (22) Fig. E. The width of these pieces, however, is such that they do not quite touch the side of the rectangular frame comprising the enlarging back but leave a 1/16″ space, as indicated at (23) Fig. E. It will be apparent from the foregoing description that the three pieces of wood attached to each side of the main frame of the enlarging back form a housing which completely incloses the side curtains of the bellows, and the ends of the bellows members slide through the spaces between the housings and the rectangular frame. As the bottom edges of these housings are even with the bottom of the main frame of the enlarging back which is raised about 1/16″ above the surface of the main base, they do not slide on the main base. Strips of black felt, whose lower edges press against the main base may be attached to the lower inside walls of the housings, thus effectively blocking out any light that might leak in along the lower edges of the housings.

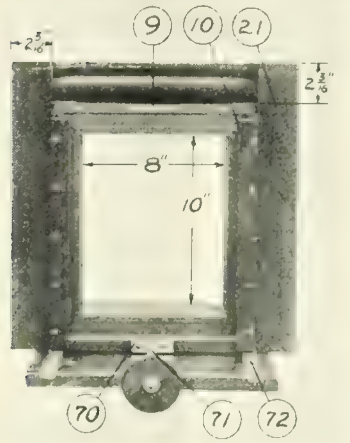

Fig. O

The top curtain (27) Fig. E is 13″ wide so its roller may be held by little brass plates screwed to the inner surface of the side housings. A housing similar to those on the side of the enlarging back is fitted on top of the main frame. In Fig. E the top of this housing has been

removed and is seen lying on the main base. Its back edge is cut away as at (9) Fig. B, providing ample clearance for the insertion and removal of the plate holder and focusing screen. Another piece of wood (80) Fig. C is attached to the front edge of the top piece of this housing and like the two side pieces (24) Fig. E it leaves a $1/16''$ space for the top curtain to pass through.

The opaque shades forming the bellows members should be made up with a $1/2''$ stitched edge along either side which greatly stiffens the material. The rollers are ordinary window shade rollers cut down to the proper lengths. The little "dogs" or pawls which drop in notches in the end of the rollers, when they are hung horizontally at a window to hold the curtain at any point, should be removed before the rollers are permanently installed or they may be put out of commission quite easily by pressing a bit of gum or wax on them after they have been moved as far as they will go from the notches.

The two side curtains pull out directly through their slits into the grooves (78) Figs. Q and S. The top curtain pulls out through its slit, and as the side curtains are even with the top surface of the main frame of the enlarging back, the top curtain rests on the upper edges of the side curtains.

The housings are necessary to prevent light leaking into the inside of the bellows at the enlarging back end of the apparatus. This construction affords a very simple yet serviceable bellows, light tight enough for use in a room illuminated by artificial light, but it may be made strictly light tight, however, by throwing a focusing cloth over it during exposures.

Before leaving the subject of the enlarging back and the bellows, it may be remarked that these two items need not be built if it is desired to limit the construction of the apparatus to a projection printer. As was pointed out earlier, the apparatus here described serves a dual purpose and to use it as a self-contained unit it is necessary to build the enlarging back and the bellows. It is obvious too the construction of the shorter section of the main base may be eliminated if one is going to confine the construction to a projection printer.

The Auxiliary Base, Figs. F and G, is constructed of four pieces of ⅞″ poplar wood glued together with tongue and grooved batons at the ends. It is 10¾″ wide and 19″ long. Its width is ⅛″ less than the distance between the inner surfaces of the guide rails of the main base. See Fig. S. A ¼″ brass rod (63) Figs. G, K and S is set in a groove in one side of the auxiliary

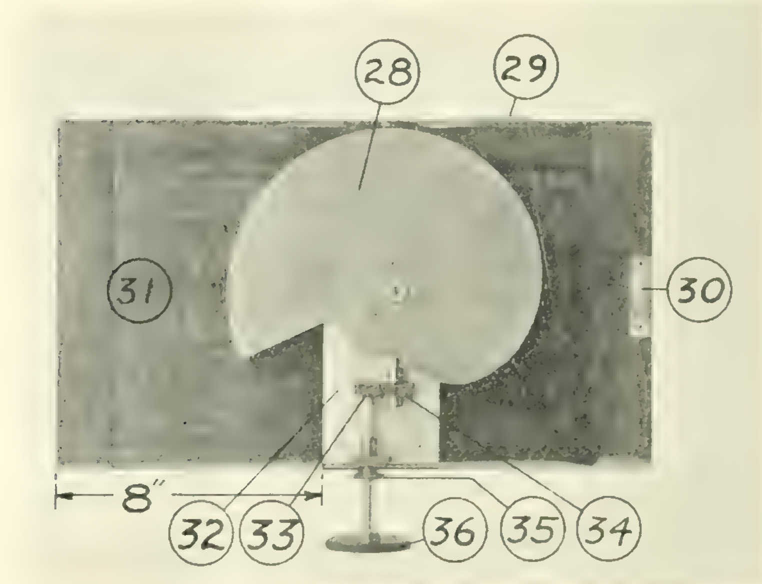

FIG. F

base and two brass springs (29) Figs. F and S are set in the other side. The surface of the brass rod projects about 1/32″ beyond the edge of the base and the two springs on the other edge keep the base pressed against one guide rail, thus reducing friction and maintaining perfect alignment. Having constructed the auxiliary base and fitted it to the guide rails so that it slides freely back and forth between them, the next step will be the construction of the cam mechanism.

Lens Foci and Enlarging. Before taking up the details of cam construction, it may be well to turn back and re-read what was said about the necessity of knowing precisely the equiv. focus of the lens to be used, and

the part played by conjugate foci in enlarging. The importance of a clear grasp of these two factors cannot be over emphasized. The accurate and smooth operation of the cam mechanism and its efficiency in automatic focus enlarging are wholly dependent upon the fitting of the cam to the precise equiv. focus of the lens. This being known or determined by careful measurement, we

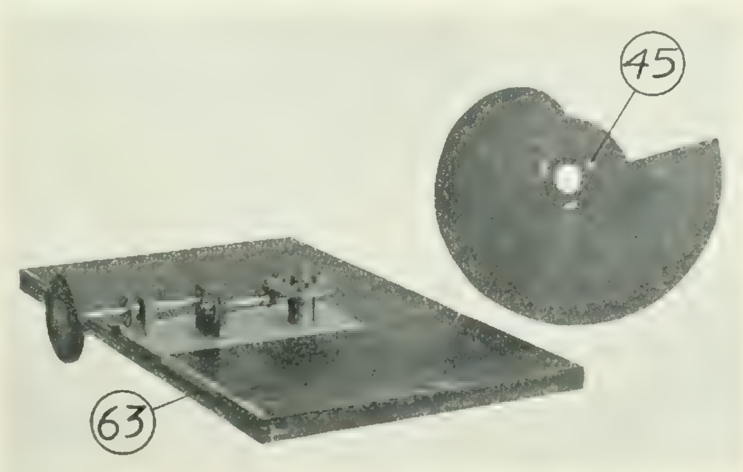

FIG. G

are now ready to consider the construction of the cam, and all references to focal lengths hereafter are to be read as meaning the exact equivalent focus of the lens in use.

We will deal with two cams, Fig. T, one being termed a 3″ cam because it has been designed for use with a lens listed as 3″ focal length, and the other a 3½″ cam for use with a lens listed as 3½″ focal length. It is understood, of course, that these cams cannot be used with any lens listed as a 3″ or 3½″ lens, but only where the 3″ lens has an exact equiv. focus of 2.874″ and the 3½″ lens an exact equiv. focus of 3.63″. If you find that your lens does not have an equiv. focus equal to either of these two above mentioned values, it will be necessary to work out individual values and develop a cam to fit your lens by following the method given on a later page.

Theory of Automatic Focusing. We have seen that the distance from the easel to the lens follows a very

simple law: degree of enlargement times the equiv. focus of lens plus one focal length. For example, suppose our enlarging lens has an equiv. focus of 3.63″, and we desire to make an enlargement of 2-times. Applying the rule just stated: 2 x 3.63″ + 3.63″ = 10.89″. For a 4X enlargement it would be 18.15″; and for a 6X enlargement it would be 25.41″. An examination of these figures discloses an interesting fact. Starting with a 1X enlargement, or where the enlargement is the same size as the original (at the major conjugate foci points of the lens), the distance between the lens and the easel is equal to the addition of one focal length to each succeeding degree of enlargement; that is, 1X enlargement equals 7.26″; 2X = 10.89″; 3X = 14.52″; 4X = 18.15″; 5X = 21.78″; and 6X = 25.41″. In other words the distance between the lens and the easel varies in a direct ratio for any degree of enlargement. If this or a similar ratio were true of the varying distances between the lens and the negative, it would be quite simple to design an automatic focusing device. Let us see how the negative distances compare with the easel distances.

The distance of the negative from the lens is equal to the equivalent focus of the lens divided by the degree of enlargement plus one focal length, which gives for the degrees of enlargement used above: 1X = 7.26″; 2X = 5.445″; 3X = 4.84″; 4X = 4.5375″; 5X = 4.356″; and 6X = 4.235″. We immediately see from a consideration of these figures that no simple ratio exists between them as is the case with the easel distances; therefore, in order to effect automatic focusing it becomes necessary to design a suitable mechanism which will cause these distances to adjust themselves automatically. [In considering these two sets of figures it is interesting to point out the fact that if we multiply any negative distance by the degree of enlargement for that distance, the result will equal the easel distance for that particular degree of enlargement. For example: take a 5X magnification. Here the negative distance is 4.356″ and 5 x 4.356″ = 21.78″ which is also the easel distance for a 5X enlargement. This constitutes a reliable check when computing the easel and negative distances, or

major and minor foci for different degrees of enlargement.]

The Rack and Pinion. We have seen from the foregoing that each added degree of magnification advances the lens one focal length further from the easel (assuming the easel to be stationary and the lens to move). A suitable rack and pinion for this work is a rack of brass 1/4″ square and 24″ long (4) Fig. A of 48 pitch which meshes with the pinion wheel, (35) Figs. G and S, 1″ in diameter having 48 teeth with a 1/8″ or 3/16″ face. The rack and pinion are regular stock articles obtainable from any gear supply house. The rack is held in a groove cut in the top of one of the guide rails starting 1/2″ from the hinged line X–X′ and extending along the guide rail a distance equal to the length of the rack. See (4) Figs. A and S. The rack makes a tight fit in this groove and projects above the surface of the guide rail 3/32″. The rack must be parallel with the raised surface of the strips set into the main base otherwise the auxiliary base, which carries the pinion engaging with the rack, might move freely when the pinion is at one end of the rack and bind at the other end if there is a lack of parallelism.

Relation Between Easel Distance and Rack and Pinion Movement. The camera employed as the enlarging lens is held rigidly in the chair device resting on the auxiliary base. Now by racking in and out the auxiliary base the distance between the easel and the lens varies according to the movement imparted to the auxiliary base by the rack and pinion. This movement accomplishes half the problem of automatic focusing.

It is necessary at this point to determine how many turns of the pinion are required to move the lens one focal length, or the equivalent of one degree of enlargement, from the easel. The lens of the Ansco Speedex camera here described has an equivalent focus of 3.63″, which is the distance the auxiliary base must move from the easel for each degree of enlargement; for a lens of 2.874″ equivalent focus the auxiliary base should move 2.874″ for each degree of enlargement. To convert this distance into terms of revolutions of the pinion gear meshing with the rack, as the pinion is 1″ in diameter,

one complete turn will move the auxiliary base a distance of 3.1416″, but it should move 3.63″; therefore, the pinion must make $1\frac{1}{6.43}$ revolutions. [It would be possible, of course, to employ a rack and pinion whose pitch and diameter were such that one turn of the pinion would advance the auxiliary base one focal length; but this would entail the construction of a special rack and pinion which would not be readily obtain-

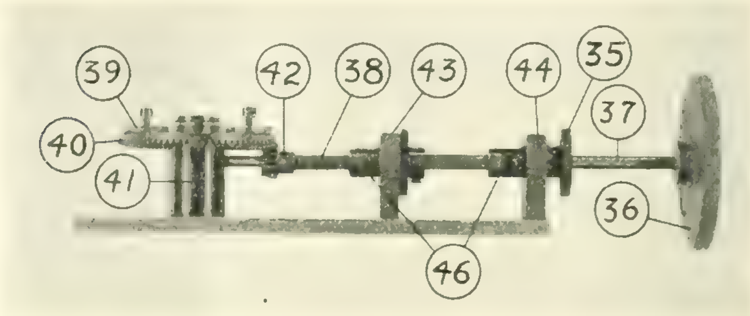

FIG. H

able as a stock article and therefore much more costly than the combination here described.]

Relation Between Negative Distance and the Rack and Pinion Movement. The next step is to work out a scheme whereby the indirect ratio of the negative distances may be coordinated with the rack and pinion movement. Suppose the axle, which is attached to the auxiliary base and to which is fitted the pinion, is also provided with a gear train actuating a small bevel gear which engages with a large bevel gear rotating on a vertical spindle on the auxiliary base. See Fig. G. As the auxiliary base is racked in and out a rotary motion is imparted to the large bevel gear. If we fasten a cam shaped metal disc to the large bevel gear the cam will turn when the auxiliary base is racked in and out. If the edge of this cam presses against a stud on the negative holder, the negative holder will move with respect to the lens while the lens is moving with respect to the easel and by causing these movements to take place in

the correct ratios the whole problem of automatic focusing will be solved.

The Cam Driving Mechanism. A sheet of brass or aluminum with the dimensions shown in Figs. F, H, I and S is set into the auxiliary base flush with the surface. A brass bearing block (44) is screwed even with the edge of the metal base. In the center of this bearing block a 1/4″ hole is drilled. The height from the bottom of the block to the center of this hole is determined in

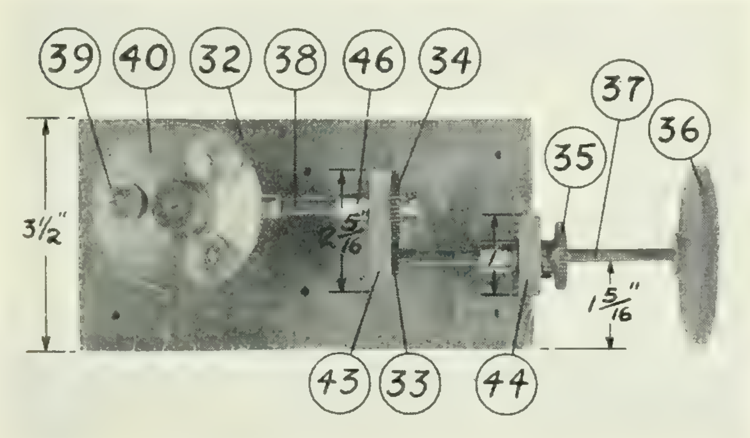

FIG. I

the following way. The auxiliary base with the metal plate set in position is slid on the main base between the two guide rails. Then the 1″ pinion is placed in position on the rack opposite the bearing block. It will now be quite easy to locate and mark the center of the hole in the block to coincide with the center of the hole in the pinion. When this distance has been ascertained all the other bearing holes in the bearing blocks and the one in the vertical spindle or pillar are drilled at the same height above the surface of the metal plate. Another bearing block (43) is also screwed to the base plate in the position indicated by Figs. H, I and S. This block has two 1/4″ holes drilled in it 3/4″ apart. A piece of steel rod 1/4″ in diameter (drill rod) 5″ long (37) rotates in these bearings. This rod or axle projects beyond the plate about 2 3/8″ and a hand wheel (36) is

rigidly attached to the outer end. The 1″ pinion wheel (35) already referred to is now rigidly attached to the axles in such a position that when the auxiliary base is moved on the main base the pinion will engage with the rack. At the other end of the axle a ½″ diameter, 48 pitch gear wheel with ⅛″ face is attached (33). The vertical spindle (41) is now screwed to the plate in the position shown, and is prevented from turning by the pin indicated in Fig. S.

Another ¼″ axle (38) rotates in its bearing in block (43) and a hole drilled in the vertical spindle. The end of the axle supported by the pillar is turned down to 3/16″ in diameter to fit the hole in the small bevel gear (42) so the hole in the pillar must be 3/16″ instead of ¼″ as in the bearing blocks. On the outer end of this axle a 1″ diameter, 48 pitch, gear wheel with ⅛″ face (34) meshing with the ½″ wheel is attached. A shoulder is turned down on top of the pillar to fit the hole in the large bevel gear wheel (40). This wheel is 2½″ in diameter, 80 teeth and ¼″ face. (The journal or the shoulder on the vertical spindle and the bevel gear comprise the vertical spindle referred to in the discussion of the hypothetical apparatus.) The small bevel gear wheel (42) is ½″ in diameter, 16 teeth and ¼″ face and is attached to the axle (38) and its teeth mesh with those of the large bevel gear. When hand wheel (36) is turned the pinion, meshing with the rack attached to the main base, causes the auxiliary base to move. The small gear (33) on axle (37) is one-half the diameter of the large one on axle (38); consequently the latter rotates one-half as slowly as the former; and as the gear ratio between the small bevel gear and the large one is 1–5, the large bevel gear makes one complete revolution while the hand wheel is making ten complete turns. [Instead of using a pair of bevel gears and the pair of spur gears to bring about this gear reduction, a more practical plan would be to employ a worm and gear. In this case the axle carrying the 1″ pinion engaging with the rack would be extended and the worm wheel attached at the far end while the gear wheel meshing with the worm would be supported on the vertical spindle. This plan eliminates the pair of intermediate

gears but entails the construction of a special worm and gear. The present arrangement was adopted because the gear train described can be purchased as stock articles from any gear supply house.]

The reason for slowing down the rotation of the large bevel gear to which is attached the cam is this. The apparatus has been designed to give a maximum enlargement of 8X. The rack and pinion movement is such that $1\frac{1}{6.43}$ revolutions of the pinion are necessary for each degree of enlargement; hence the maximum enlargement of 8X would require the pinion to revolve $8 \times 1\frac{1}{6.43}$ or a little less than ten revolutions of the hand wheel. Therefore, if we did not have a gear reduction between the pinion and the large bevel gear equal to or somewhat greater than one to nine, the large bevel gear would revolve more than one complete revolution while the hand wheel was turning through the necessary revolutions to produce the maximum enlargement of 8X. And if the large bevel gear, to which is attached the cam, should make more than one complete revolution, the cam would not function properly.

Cam Fundamentals. It is worth while to repeat that the whole problem of automatic focus enlarging is centered around a mechanical device which will automatically adjust the negative distance with respect to the lens while the lens is being moved with respect to the easel. The rack and pinion movement takes care of the distances separating the lens and the easel, and if the reader will just remember that attached to this rack and pinion mechanism and actuated by it is a train of gears which causes a cam shaped disc to revolve slowly with the edge of the disc pressing against and moving the negative carrier, he will find that auto focusing is really quite simple.

One or two simple analogies will afford the layman a complete understanding of the cam and its function. The rack and pinion supplies definite motion; i. e., if you turn the pinion a definite number of revolutions the auxiliary base will move a definite distance per turn of the pinion toward or away from the easel. It may be

likened to a stairway wherein the width and height of each step is the same. As you mount the stairway you are raised a definite distance from the floor and also moved away from the foot of the stairway a definite distance by each step mounted. As both the tread and the rise of the steps are the same for each step you could stretch a string from the first step to the last one at the top and each step in between would touch the string. Suppose, however, that the tread or width of the steps remains the same but the first step raises you say 12″ from the floor; the second step 9″; the third step 7″; the fourth one 6″; the fifth one 5½″ and the last one 5¼″, you would find that a string stretched from the first step to the last would not touch any of the intermediate steps. To touch all the steps the string would have to assume a curved shape; the sharpest portion of the curve being at the lower part of the stairway, gradually flattening out as it neared the top. The varying heights of these steps may be likened to the distances of the negative from the lens for different degrees of enlargements. Referring to page 416 giving the negative distances for six different degrees of magnification, it will be noted that the greatest distance is one degree; 2X is considerably shorter; 3X somewhat shorter; and as the 6th degree of magnification is approached the distances become more nearly the same. If we were to erect seven parallel lines from one base line, the distance separating each pair equalling the focal length of our lens (which would be comparable to making the width of each step the same in the case of the stairway) and make the length of the first line equal to the negative distance for 1X, the length of the second line equal to 2X, and so on to the last line, we would find that in order to connect the tops of these perpendicular lines we would have to draw a curved line as we found it necessary to curve our string on the stairway.

Instead of erecting these lines on a common base, we might have them radiating from the center of a circle like the spokes of a wheel, with the angle between each pair the same. Starting from any one line we might lay off the distance from the center of the circle equal to the negative distance for 1X; the second line equal to 2X;

the third 3X; and so on, and to connect the ends of these spokes or radii, we would have to draw an irregular curve.

By modifying the above procedure slightly and drawing the curve on the rotating disc attached to the large bevel gear mounted on the vertical spindle of our hypothetical apparatus, and then cutting the contour of the disc to conform to the irregular curve, the disc will move the negative holder a large or small distance according to the varying periphery of the cam, while the lens is moving with respect to the easel; and this disc with its irregular curved periphery is the cam of the automatic focusing apparatus.

Construction of the Cam. The reader's attention is now directed to Fig. T which is a full-sized drawing of a cam suitable for the two most popular miniature cameras, those with lenses approximating 3″ in focal length, and those of approximately 3½″. Looking at the illustration with the legend Fig. T at the bottom of the drawing, the illustration is in the correct position for considering the development of the 3½″ cam which is indicated by heavy lines. Turning the page clockwise through 90 degrees, or until the legend, Fig. T, is at the left, the illustration is correctly positioned for the development of the 3″ cam, which is indicated in light lines. Only the outline of the 3½″ cam is drawn heavy, however, the radii of both cams being drawn alike. The 3½″ cam will be dealt with here, but for those who plan to build an apparatus for 3″ lenses, it is only necessary to state that exactly the same procedure is to be followed, substituting the 3″ drawing for the 3½″ one, likewise the other data supplied. (For those who desire to follow through the actual theory and design of the cam, the complete development including the necessary formulae, calculations and tables are given later under the subtitle *Cam Design.*)

Sheet brass 1/16″ thick is an excellent material with which to make the cam, although sheet aluminum could also be used. The first step is to trace the drawing of the cam on the metal plate. The drawing is attached to the sheet of brass by several dabs of paste or glue (Grippit is good for this purpose). The whole sheet should not be

covered with the adhesive as this might distort the drawing thus destroying its accuracy. When the drawing has been attached mark the center O Fig. T of the cam by a prick mark. A mechanic's scriber, stout needle, or any sharp metal point will do this accurately. Next prick mark the points along the outline of the cam including the three holes (45) Figs. G and T, by which the plate is fastened to the large bevel gear. After all the points have been marked the drawing may be removed from the plate. The contour curve of the cam should now be drawn through the points on the metal plate; also the major radii; i. e., OE, 2.0, 3.0, . . . 8.0.

If the foregoing instructions are carried out accurately an exact duplicate of the cam drawing, excepting the minor radii, should appear on the plate.

A Word of Caution. The reader has probably realized by now that the cam is the heart of the apparatus and the one part requiring the greatest care in its construction. Manifestly then any inaccuracy in exact dimensions of the cam will be serious. While making the transfer it is well to check the work occasionally by measuring some of the radii drawn on the metal plate and comparing the results with the distances given in the table for the cam under construction. This is advisable because the engraving of the drawing may vary slightly from the original, or some slight error might be made in the transfer. All measurements are to be made from the outside edge of the circumference of the base circle, first subtracting 2 from each radius length, because the distance from the center of the base circle is 2″, and more accurate measurements are possible when working from the edge of the base circle outline.

If the dimensions of the various parts of the drawing on the metal plate check with those of the figure in the monograph and with the dimensions given in the table, or with the dimensions computed for the particular lens used, the cam is ready to be cut out to shape. It should be cut out roughly, first, care being taken not to run inside the line of the curve. After this has been done the final grinding or filing down to the line of the curve is made. This part of the work must be done very accurately, filing or grinding as close as possible to the line.

A $\frac{3}{4}''$ hole is next made very carefully at the center of the cam for the purpose of centering the disc on the vertical spindle.

Another and Better Way to lay out the cam is this. Having roughly located the center of the cam on the sheet of metal, the $\frac{3}{4}''$ hole is drilled. Now turn down a shoulder, the height of which is about the thickness of the metal plate, on a piece of brass rod which will fit the $\frac{3}{4}''$ hole snugly. Before the piece of metal rod is removed from the lathe a very small center hole is made. The sheet of metal is now placed on the brass stud and the engraving of the cam placed on it so the center of the latter exactly coincides with the center hole in the stud projecting through the $\frac{3}{4}''$ hole in the plate. The balance of the work of transferring the drawing to the plate is then carried on as already described. By drilling the hole first all danger of drilling it off center after the outline of the cam has been transferred to the sheet of metal is avoided.

The three elongated holes (45) Fig. T are then drilled in the plate. It will be apparent from Figs. F and G that the cam fits on a shoulder turned down on the vertical spindle and rests on top of the large bevel gear to which it is attached by three screws passing through the elongated holes already mentioned.

The apparatus as far as we have considered it now consists of the enlarging back, the main base and an auxiliary base which slides back and forth on the main base by means of a rack and pinion movement which in turn actuates a train of gears causing the cam to revolve slowly on the vertical spindle. The parts of the apparatus carried by the auxiliary base will be described next.

The Camera Bracket, which carries the camera whose lens is used for the enlarging lens, resembles somewhat a chair without a back (15) Fig. L. The camera (16) Fig. B, with its back removed and platform opened and bellows extended, fits into this chair device with the platform resting on the bottom of the bracket. The front of the lens faces the enlarging back. No working dimensions are given for this part of the apparatus as its shape and dimensions will have to be modified to hold

different types of cameras, but the distance between the surface of the main base and the optical axis of the enlarging lens is determined as follows: The center of the plate holder is first found by drawing diagonals on the slide. The distance is then measured from the intersection of these diagonals to the surface of the main base after the holder has been inserted in the enlarging back and this distance will be the correct distance between the main base and the optical axis of the enlarging lens.

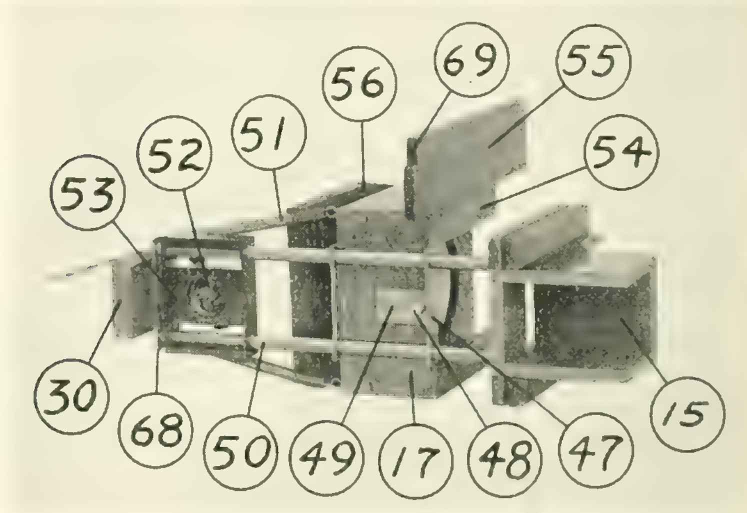

Fig. J

The bracket is mounted at the left end and in the center of the auxiliary base by screws which pass up through the auxiliary base into the bracket.

The Condenser Housing, Fig. S, is a box constructed of ½″ poplar wood; its principal dimensions are indicated in Fig. S where a front and side elevation of the condenser housing is shown. The pair of plano-convex lenses comprising the condenser are 4½″ in diameter and have an equivalent focus of 2½″. Holes 4″ in diameter are cut in the center of the front and back faces of the box with circular rebates (78) Fig. S, ⅜″ deep and ¼″ wide into which fit the condensers, these being held in position by the spring wire rings (70) which snap into place after the condenser elements have been inserted

in the grooves. When the parts of this housing are being constructed provision may be made for the insertion of a sheet of ground glass in a groove (76) between the two condensing lenses; although a better plan is to have the ground glass between the light source and the condensers as (62) Fig. K.

Two strips of wood (54) Figs. J and S are screwed to either edge of the back face of the housing next to the camera bracket. These wooden pieces form a slide into

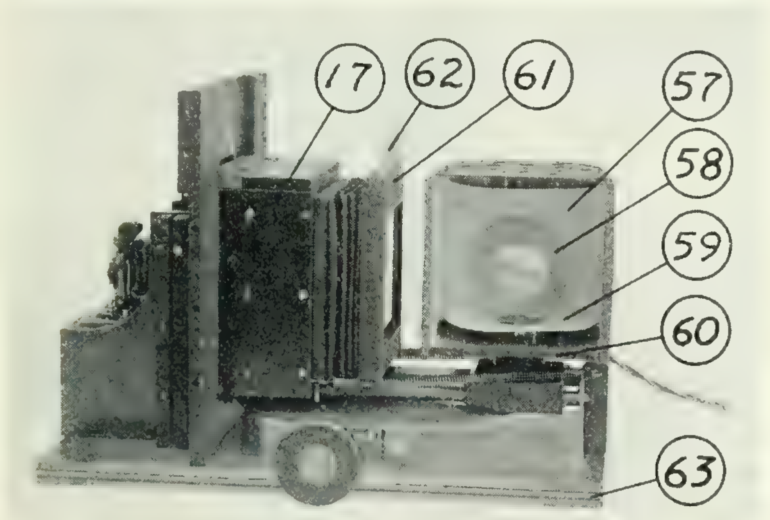

FIG. K

which fits the negative holder (82) Fig. S, and this is held in place against the face of the housing by means of flat bowed springs (77) set in either strip. As will be seen from Fig. S, the top of the condenser housing is built with a hinged section (20) swinging up in the direction of the arrow when the negative holder is inserted or withdrawn.

The Negative Holder, Fig. P, is quite simple to construct. It consists of a 4 x 5 printing frame which has been cut down to ⅜″ in thickness. The ordinary hinged back is replaced by two U shaped metal sections (73), Fig. P, ⅛″ thick, hinged to the frame. The rectangle inclosed by the opening formed when the two

metal sections are closed measures 2½" x 3½", or ⅛" greater each way than the maximum size of the negative to be enlarged. See Fig. R which shows the hinged pieces flat.

Two swiveling bowed springs with notches (74) Fig. P are attached to one of the hinged sections. The notches engage under the heads of two protruding screws in the other piece. A sheet of clear glass 4 x 5

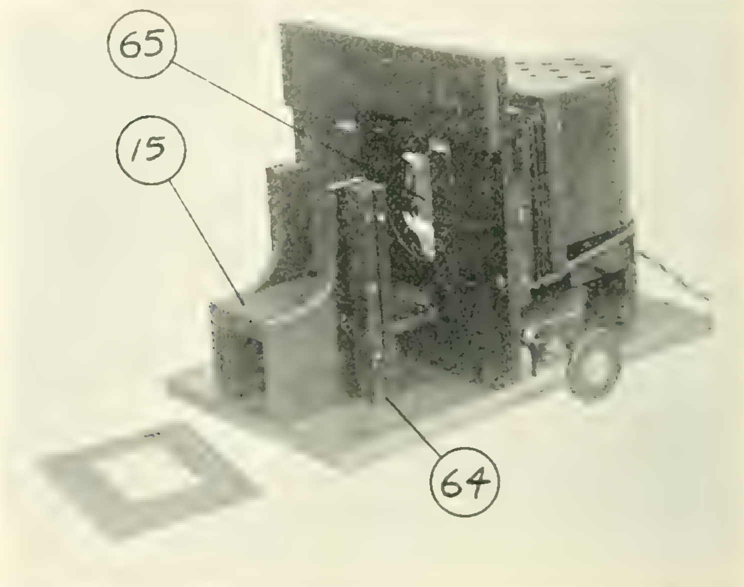

Fig. L

inches is placed in the printing frame, the negative is placed on this sheet of glass, emulsion side up, and a paper mask is put over the negative. The hinged members are then pressed down and the springs caught under the screw heads. These springs exert sufficient pressure to hold the negative in flat register with the glass and the entire construction is such that no glass is between the negative and the lens, thus avoiding any distortion that might arise if glass came between the negative and the lens.

When the printing frame or negative carrier is inserted in the grooves formed by the two wooden pieces

attached to the back side of the condenser housing, the center of the frame will be on the optical axis of the apparatus with the negative, emulsion side towards the lens, about 3/8″ from the surface of the rear condenser element. If the apparatus is to be used with both plate and film negatives, strips of cardboard the thickness of the glass negatives must be inserted between the printing frame and the condenser housing, when using film negatives, to compensate for the difference in thickness between them. This must be done to insure both emulsion surfaces registering in the same plane. The negative masks (75) Fig. P are made of thin bristol board and fit the frame snugly; i. e., without any appreciable movement. Several of these masks should be made up containing different sized openings. Thus any portion of a negative may be masked by shifting the negative under the mask before the springs are pressed down, and the construction of the holder insures the masked portions of the negatives being correctly centered on the optical axis of the apparatus. As the

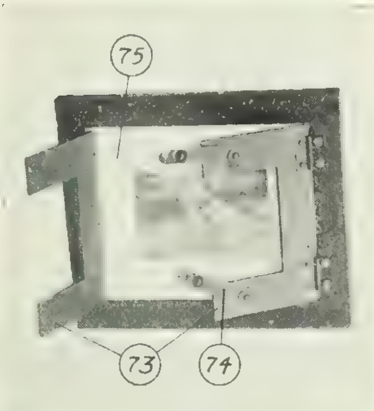

Fig. P

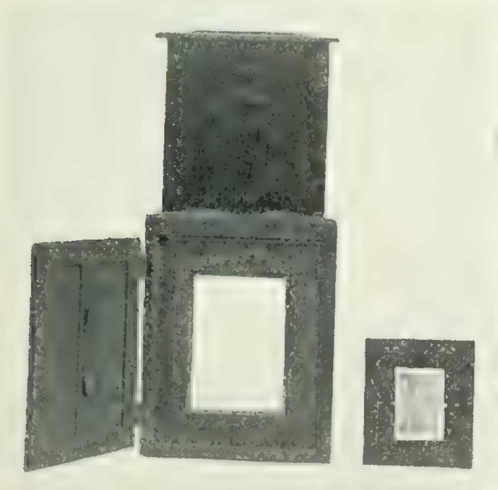

Fig. R

greatest dimension of the negative is but 3¼″ and the smallest of the printing frame 4″ and the clear surface of the condenser 4″ in diameter, the negative may be turned in any position to mask properly such portions to be enlarged.

The Bridge Over the Cam Mechanism. The negative must be free to move back and forth with respect to the enlarging lens while the latter moves with respect to the easel. This is accomplished by a bridge over the cam mechanism. Two brass rods (50) Figs. J and S, ½″ in diameter and 14¼″ long are attached to the camera bracket at one end of the auxiliary base and to a block of wood (30) at the other end. These rods are 3⅛″ between centers. Holes are drilled and tapped in the ends of the bridge members to receive machine screws. Two brass plates with holes in them 3⅛″ apart and fitting the screws just mentioned are then screwed to the ends of the rods. These brass plates (68) Figs. J and M are attached to the camera bracket and the wooden block by screws.

Two similar brass plates (47) with ½″ holes 3⅛″ between centers are next fastened to either bottom edge of the condenser housing. Two grooves (81) Fig. S, ⅝″ wide and ⅜″ deep are cut in the bottom of the housing at the proper point to afford clearance for the bridge rods.

If the work has been done correctly it will now be found that when the block and the camera bracket to which are attached the ends of the bridge members, are placed on the auxiliary base, the condenser housing will slide freely on the rods, clearing the cam mechanism beneath. As will be apparent from the illustrations, the distance from the optical axis of the condensing system to the main base is the same as the distance of the axis of the enlarging lens and the intersection of the diagonals of the plate holder in the enlarging back to the main base; and the metal plates supporting the condenser housing and which slide on the bridge rods do not touch any part of the cam mechanism below.

The Cam Stud. Before the bridge is attached permanently to the auxiliary base the stud, against which the cam presses, should be attached to the bottom of the

condenser housing. The stud, (48) shown in cross-section in the side view of the condenser housing in Fig. S, is a steel roller in the form of a tube about ½″ in diameter and ½″ long (48). It makes a nice rotating fit on the shank of the steel screw which screws into the brass plate (40) Figs. J and S. The edge of the cam (28) Fig. S rolls on this roller, the roller revolves on the screw, thus reducing friction to a minimum.

The Illuminator or Lamp House (57) Figs. C and K is constructed of metal. Its base (60) Fig. K is a piece of aluminum ¼″ thick and 5½″ long. The sides are square with the front for a distance of 2¾″ then follow the arc of a circle whose radius is 2¾″. The lamp socket is a metal display sign socket and is fitted tightly into a metal sleeve (66) Fig. M. (52) Fig. J shows the bottom of the socket where the wires are attached. This sleeve makes a sliding fit in a metal tube (67) Fig. M which is attached to a metal plate or stage (53) Fig. J. A set screw lacks the socket and its containing sleeve at any height. The stage moves laterally with respect to the bridge rails by sliding in grooves cut in two metal plates which in turn slide on the bridge rails. This construction affords a vertical movement, a lateral movement and a back and forth movement of the lamp socket on the bridge rails; thus the electric lamp may be raised or lowered until the filament (center of illumination) is on the optical axis of the apparatus, and the lamp stage may be adjusted with reference to the condensing system so the cone of light emerging from the condensers comes to a focus on the enlarging lens.

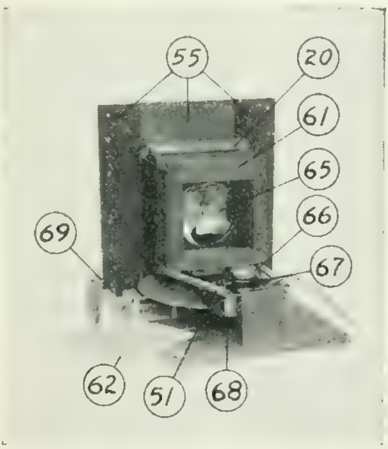

Fig. M

The lamp house proper is made of sheet tin or preferably of polished nickel plated sheet brass because it has

been found by experience that it is difficult to get a suitable white enamel for the inside of the house which will withstand the intense heat given off by the lamp. Nickel plated brass or polished aluminum will afford nearly as much reflection and diffusion of the light rays as a white enameled surface and will not be affected by the heat. The walls of the house are about 6″ high which brings it nearly to the same level as the top of the condenser housing. It is fastened by screws to the base plate. A top of metal and similar in shape to the bottom is riveted to the walls. Both the top and the bottom are pierced by $\frac{1}{2}$″ holes to afford ventilation; and to prevent light passing through these holes, two baffle plates 5″ in diameter (59) Fig. K are placed inside the housing but separated from the top and bottom a distance of $\frac{1}{2}$″ by metal pillars. The base is pierced at the center of the arc of the circular end by a hole threaded to screw on top of the sleeve (66) Fig. M moving vertically in the tube (67) Fig. M attached to the stage sliding on the bridge members. The lamp (58) Fig. K is a 250-watt stereopticon bulb. The lower baffle plate is provided with a hole $1\frac{5}{8}$″ in diameter through which the bulb passes when it is screwed into its socket.

Fig. K shows the lamp house partly unscrewed from its support so the inside construction is apparent. The side walls of the house are made about $\frac{3}{8}$″ longer than the base plate and these are bent at right-angles and drilled with three holes. The distance of the light source from the condenser varies with different degrees of enlargement, and to prevent light leaking out between the condenser housing and the lamp house, a simple bellows of square form (56) Fig. C closes the opening. The making of such a bellows was described in THE PHOTO-MINIATURE: No. 123. One end of this bellows is fastened to the condenser housing and the other terminates in a wooden frame (61) Figs. K and M which is attached to the lamp house by means of the bent portions of the side walls of the lamp house already described. This frame is provided with a groove which holds a sheet of ground glass (62) Figs. K and M. It was pointed out on page 427 that instead of placing a sheet of ground glass between the condenser elements

a more preferable method would be to insert the ground glass between the condensing system and the light source. Fig. M shows the lamp house removed from its support and the ground glass withdrawn from the groove in the wooden frame.

Condensers vs. Diffusers. The apparatus as described employs a condensing system because this type of illumination affords very rapid exposures when using chloride papers. Exposures of from 15–20 seconds from average negatives are possible using the condensing system. The construction of the apparatus could be greatly simplified, however, by eliminating the condensing system. In this case it would be necessary to place several sheets of ground glass between the lamp and the negative, necessitating longer exposures. The substitution of greatly diffused illumination does away with the construction of a condenser housing and the bellows; it also enables one to employ such illuminators as the Craig or Parallax apparatus obtainable commercially.

Some Minor Details. We will now consider the assembly of the apparatus. The auxiliary base with its fitments is slid onto the main base between the guide rails. The pinion engages with the rack and by turning the hand wheel the auxiliary base moves back and forth on the main base. It is necessary to devise a means for attaching the free ends of the window shade bellows to the auxiliary base. Fig. M shows the method adopted for doing this. The wooden strips (55) Figs. B, M and S, with the dimensions indicated in Fig. S, are attached to the condenser box. These strips do not quite touch the surface of the auxiliary base and a notch as indicated at (69) Figs. Q and S is cut in each one as clearance where they extend over the guide rails of the main base. The two strips attached to the sides of the condenser box and the cross strips joining them at the top and bottom, Fig. S, move integral with the condenser box and negative carrier. It is necessary, therefore, that the bottom edges of the strips do not touch the surface of the auxiliary base as already stated. This space need not be more than 1/16″ or 1/8″ and a strip of felt, indicated by the heavy black line in Fig. S, glued to the

lower edges of the side pieces and the bottom cross piece, and sliding on the surface of the auxiliary base, will effectively block out any light leaking in at this point. The total height and width of this frame is of about the dimensions of the opening inclosed by the three window shades and base forming the bellows; so that the sides and top of the frame actually contact with the side and top bellows members; and as the bottom of the frame is rendered light-tight by means of the felt, very little, if any light leaks in. The free ends of the window shades are attached to the frame (55) by thumb tacks.

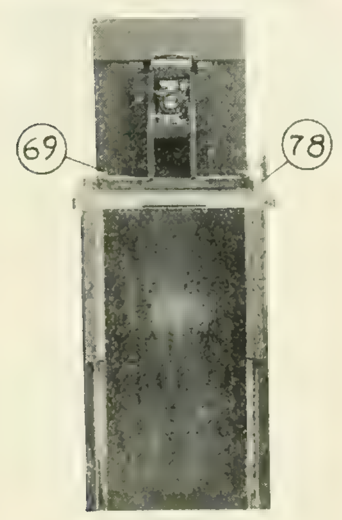

Fig. Q

Any stray light leaking in at the condenser housing end of the bellows is prevented getting to the bromide paper in the enlarging back by a baffle plate (64) Fig. N inserted in slots formed by wooden pieces screwed to either side of the camera bracket (15) Fig. L. The dimensions of the baffle plate are the same as those of the rectangular frame (55) just described, and the lower edge does not come quite to the surface of the auxiliary base; and the two bottom corners are cut away like the frame (55) Fig. M, to form clearance for the guide rails. Fig. N shows the baffle plate, which is made of cardboard painted dull black, in place, and Fig. L shows it removed.

When the auxiliary base is racked away from the enlarging back the cam moves the negative towards the lens and so long as this movement is continued the cam presses against the stud under the condenser housing. If the auxiliary base is racked towards the enlarging back, however, the stud does not follow the

cam. It is necessary therefore to provide a pair of coiled springs (51) Figs. J and M which pull the condenser housing against the cam at all times. These springs must be strong enough not only to keep the stud pulled against the cam but to overcome the opposite pull of the springs in the window shade rollers.

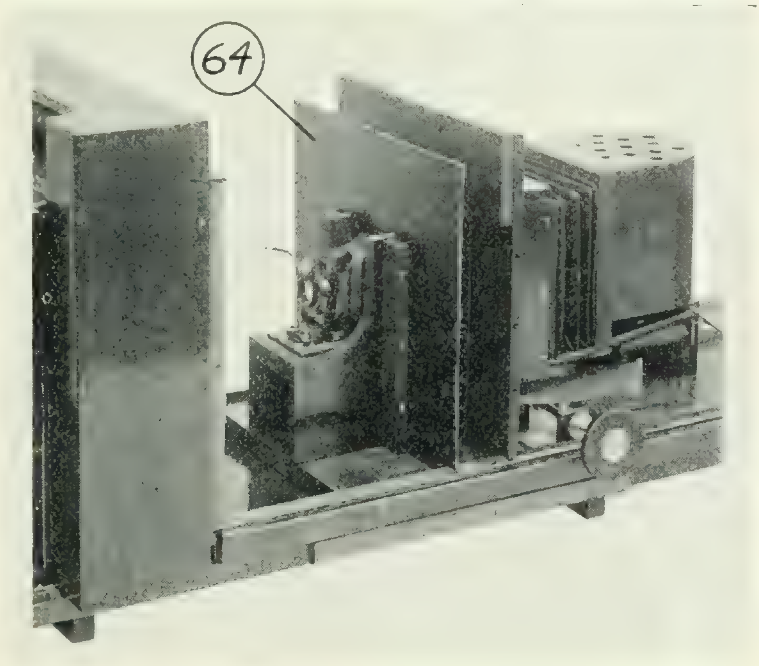

FIG. N

Heavy rubber bands would do as well as wire springs but they suffer rapid deterioration

Assembly and Adjustment. We are now ready for the final assembly and adjustment of the apparatus. The auxiliary base is started between the guide rails at the right-hand end and pushed along the main base until the pinion engages with the rack. The hand wheel is then turned, rotating the cam, as the auxiliary base is racked towards the other end, and by the time the auxiliary base has reached a position on the main base approximating one degree of enlargement, the cam may have turned around to a point corresponding to

about an 8X enlargement. To avoid this it is necessary to rotate the cam around to a point on the periphery at the end of the 8X radius before the auxiliary base is started toward the other end of the main base. When the pinion then engages with the rack the cam will unwind, so to speak, as the auxiliary base is racked towards the easel end. After the position of about 1X enlargement has been reached it will be found that the cam has also reached a point where it touches the stud corresponding to a 1X enlargement.

Having racked the auxiliary base down towards the enlarging back, with an approximately correct setting of the cam, the next step is to make the adjustment for say a 3X enlargement between the focusing screen, the enlarging lens and the negative. The distance from the nodal point of emergence to the focal plane of the lens, or in this case, to the emulsion side of the negative which should face the enlarging lens is 4.84″ (negative distance for a 3X enlargement), for a lens having an equiv. focus of 3.63″. With a lens of any other equiv. focal length the factor 3.63″ should be replaced by the equiv. focus of the lens used.

If the nodal point of emergence of the lens is not known it must be determined by trial. In the case of a symmetrical lens, however, the nodal point is usually at the center of the iris diaphragm or the back surface of the diaphragm. With a lens of the unsymmetrical type we proceed as follows. After the reference mark is made on the platform or bed of the camera indicating the distance the lens should be from the emulsion surface of the negative (4.84″ for the case under consideration) for a 3X magnification when the point on the periphery of the cam at the end of the 3X radius is in contact with the stud roller, the camera is adjusted on the bracket until this mark is exactly 4.84″ from the negative. The lens mount or support is now moved so the approximate center of the lens coincides with the mark. The ground glass focusing screen is then placed in the enlarging back and by means of the critical focus adjusting screw (71) Fig. C the focusing side of the glass is moved to a point 14.52″ from the reference mark on the camera (14.52″ being the

easel distance for a 3X magnification or enlargement).

When the above adjustments have been made we have the following conditions. The point on the periphery of the cam at the end of the 3X radius is touching the roller on the negative carrier; the distance from the emulsion surface of the negative to the reference mark on the bed of the camera is 4.84″; and the focusing screen has been set at the proper distance from the reference mark for a 3X magnification; the lens also occupies an approximately correct position. To set the lens precisely the negative is illuminated and the lens *(not the camera)* is moved back or forth on the camera bed until the image on the ground glass screen is sharp. A good way to do this is to draw a line say 2″ in length on a negative and then adjust the lens until the image of the line is 6″ in length. When these adjustments have been made, the lens occupies the correct position for enlarging and by measuring forward 3.63″ from the focal plane of the camera to the lens the nodal point of emergence of the lens is determined.

When the above adjustments are completed the exact position occupied by the lens should be marked on the camera so when it is removed the camera and lens may be replaced at the right point for automatic focusing. Should the camera not be of the platform type, but one where the front is extended and held rigidly in place, focusing being accomplished by moving the lens in the lens mount, note should be taken of the position occupied by the lens when it is in final adjustment so it may be returned to this point each time the camera is used as an enlarging lens. It is obvious, of course, that the camera itself should occupy the same place on the camera bracket every time it is put in position for enlarging.

The apparatus is now in final adjustment and any racking in or out of the auxiliary base will cause the image of the negative on the focusing screen to grow or shrink in size, remaining critically sharp the while.

The cardboard baffle plate is next placed in position and the side curtains forming the bellows attached to the frame on the condenser housing.

Adjustment of the Illuminant. The lamp should now be adjusted. Remove the negative holder and adjust

the lamp back and forth on the bridge rods until a bright circle of light, as free as possible from color, is projected onto the ground glass. If the light is too bright near the top of the circle the illuminant should be raised slightly until the circle of light is of even brightness throughout its area. When an evenly illuminated circle of light has been obtained, correctly centered, replace the negative and holder and rack the auxiliary base out to say a 4X magnification of some part of the negative. Now remove the negative holder again and examine the circle of light. If it is bright and even all over it is correctly adjusted. If too bright in the center, the light is too far away from the condenser and should be brought forward until the disc of light is evenly illuminated. If, on the other hand, the center of the disc is dark, the light is too near the condensers, and must be pushed further away. These adjustments should be made without the ground glass inserted between the condenser and the illuminant. When they have been made the ground glass may be replaced.

Condensers like other lenses possess conjugate foci and for this reason it is necessary to adjust the position of the illuminant with respect to the condenser system as the degree of enlargement changes in order to have the apex of the cone of light formed by the condensers will always focus on the enlarging lens. For small changes in magnification of the projected image the position of the illuminant as found above need not be altered, but if a great change is required in the size of the projected image, for instance from 2X to a 6X enlargement, the illuminant should be adjusted until the circle of light is even. In fact it is a good plan to mark on the bridge rods, points where the illuminant should be placed for the major degrees of enlargement. When enlarging it is only necessary then to slide the lamp housing on the rods to the point which corresponds approximately with the degree of magnification being used. It is also desirable to indicate along the guide rail holding the rack the major divisions of magnification.

Size of Enlargements. It is to be understood, of course, that it is not possible to amplify a 2¼x3¼ negative to a full 8X enlargement when using the ap-

paratus as a self-contained unit, because the sensitized material holder will only accommodate an 8 x 10 sheet of enlarging material which is somewhat smaller than a 4X enlargement. When it is desired to enlarge such negatives to a full 8X size the apparatus must be used with independent easel. It is possible, however, *to enlarge portions* of these negatives to 8X with the apparatus in the self-contained form; and enlarging small areas of negatives will constitute a considerable part of the work done with the amplifier.

The Apparatus as an Automatic Projection Printer. So far we have considered the apparatus in the form of a self-contained enlarging camera producing a maximum enlargement of 8 x 10. As was stated earlier the apparatus is made to serve a dual role. Fig. A shows the main base as a continuous unit hinged on the line X-X. The brass strips (18) Fig. B screwed to the edges of the main base hold it in the flat form. In Fig. D the screws holding that portion of the brass strips attached to the shorter section of the main base have been removed and this section swung down. Before the short section is dropped, the enlarging back must be removed from the main base by unscrewing the upright stud (19) Fig. C, holding the threaded axle of the critical focusing device, from the end of the main base and lifting the enlarging back with its window shade rollers, etc., from the grooves in the main base; the free ends of the shades having been detached, of course, from the frame fastened to the condenser housing on the auxiliary base.

The horizontal section, Fig. D, rests on a table or other support. The point at which the main base is hinged and the projecting ends of the brass strips must be so determined, that lines drawn from the enlarging lens to the outer limits of the 8X enlargement are not intersected by these projecting strips. Fig. Q shows an end view of the apparatus with short section dropped down.

It is necessary, when using the apparatus in this form, for enlargements greater than 8 x 10, to work in a darkened room. The apparatus rests on a table and the easel is suspended on a wall or otherwise supported at the proper distance from the table on which rests the horizontal section of the main base and the balance of the

apparatus. This distance is determined as follows: The auxiliary base is racked out to any convenient point, say where it will give a 4X enlargement. The easel is then adjusted until the image is critically sharp. This is the correct position for the easel, because any further racking in or out of the auxiliary base will only increase

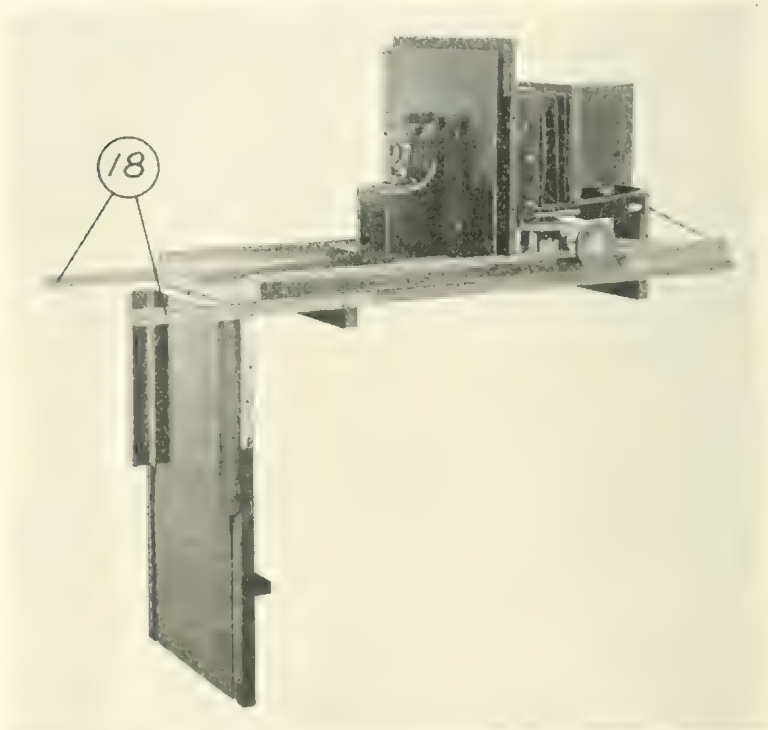

Fig. D

or decrease the size of the image without altering the focus; i. e., we now have the same conditions to work under as though we were using the outfit as a self-contained unit except that we have substituted an easel for the enlarging back.

It is perhaps well to remark at this point that when the outfit is in the self-contained form it is not possible to make corrections for distorted images, especially of negatives showing distortion of the vertical lines, as in architectural subjects, etc. The only adjustment possi-

ble and desirable from many standpoints is the one of centering such portions of the negatives to be amplified on the optical axis of the apparatus; neither does the negative holder turn in a plane parallel to the easel. This adjustment is taken care of when the negative is masked and placed in the printing frame holder. This holder is large enough to allow the negatives from miniature cameras being turned in any position parallel to the bromide paper holder.

Advantages. In the apparatus under discussion the sensitized paper holder, the lens system, the negative, and the illuminant are unalterably centered correctly with respect to the optical axis of the device, insuring perfect illumination at all times; a much more desirable and necessary feature than some of the many elaborate adjustments found in other types of enlargers and which are seldom required. When they are needed the apparatus used with independent easel, which may be tilted or otherwise adjusted, will take care of them satisfactorily. In other words the device is as near fool and trouble proof as it is possible to make one. It will be found that out of all negatives about 90% of them will be just plain straight enlargements between 5 x 7 and 8 x 10. With the remaining 10% it may be desirable to enlarge greater than 8 x 10 or they may require corrections, dodging, vignetting, etc. When any of these operations are necessary, the apparatus must be used as any other type of automatic enlarger—in a dark room. It may be well to remark too that soft focus effects can be obtained with the apparatus in either form if lens "spectacles" or supplementary lenses are used in conjunction with the lens belonging to the camera, providing they do not alter the focal length of the lens. Or bolting silk may be used by the method outlined on page 410.

Fig. C shows the apparatus as a complete unit in the self-contained form ready for use. When it is desired to place the camera in its support or remove it, the free end of the top curtain of the bellows is detached from the auxiliary base and allowed to roll up to the other end, care being taken that it does not slip through the groove. The baffle plate of cardboard is then withdrawn and the camera taken out or inserted in its sup-

port; the baffle plate returned to its place and the curtain attached.

The Material and Parts needed for the construction of the foregoing automatic negative enlarger may readily be secured in most large towns, as follows: Lumber, well seasoned poplar wood and hardwood strips, from any lumber merchant or mill. The gears, toothed rack and similar metal parts from dealers in machine parts and supplies; condensers from photographic supply dealers or lens makers. The bromide paper holder suggested is that listed by the Eastman Kodak Company; window shades are obtainable from dry goods and upholstery stores. The illuminant is a 250-watt concentrated filament electric lamp sold by dealers in electrical supplies. It is estimated that the enlarger, home-made, should not cost more than fifteen or twenty dollars (less abroad) including the above mentioned items.

Automatic Enlargement of Large Negatives. The design and construction of the automatic enlarging apparatus described in these pages has been confined to a device for enlarging negatives produced with lenses of 3½″ focal length or less because of two reasons: (1) Our subject has been enlarging and the miniature camera and lenses of these small cameras rarely exceed 3½″ focal length; (2) The lens producing the small negatives is usually a high grade anastigmat covering completely the focal plane of the camera on which it is employed. Some readers may desire to design and build an automatic enlarger similar in principle to the one described but capable of making enlargements from negatives as large as 5 x 7″. For those who are interested in a larger automatic focusing apparatus let us see what modifications of the miniature camera apparatus are necessary in order to adapt it to large negatives.

The Lens. The focal length of the enlarging lens should be determined by the size of the negative to be enlarged and a safe plan is to have the focal length of the enlarging lens at least the equivalent of the diagonal of the negative to be enlarged. For instance, a 3½″ lens is about right for negatives 2¼″ x 3¼″, although 4″ would be better; a 4 x 5″ negative should have a 6 or

7″ lens; and for a 5 x 7″ negative a 9 or 10″ lens should be employed.

We have seen that for each degree of enlargement the rack and pinion movement must advance the lens a distance of one focal length. In the case of the miniature camera lens described in the text, this amounted to 3.63″ per degree of enlargement and for a 3″ lens, 2.874″ when the equiv. foci of these lenses are 3.63″ and 2.874″ respectively. Suppose, however, we desire to employ a 6″ lens for enlarging say 4 x 5″ negatives. Here the rack and pinion movement must be of such proportions that it will advance the lens 6″ per degree of enlargement if the equiv. focus of the lens is 6″; and a 9″ lens used with 5 x 7″ negatives would advance the lens 9″ per degree of enlargement. Obviously from these considerations it is apparent that the length of the main base of the apparatus as well as the rack and pinion movement will have to be modified to meet the new conditions. The length of the main base and the other components of the apparatus are easily altered, but a modification of the cam which regulates the negative distance is not so simple. We found that a cam developed on a 4″ circle was practically ideal for the miniature camera machine. Its largest dimension was less than the width of the main base, and although it might have been developed on a smaller base circle, for practical construction the size determined upon was satisfactory. If we employ a cam construction similar to the 3 or 3½″ cams, already described, for use with a 6 or 9″ lens it will be necessary to build these cams on a much larger scale.

By a comparison of the distances given in the table which follows, we will see that for each degree of enlargement, using a 3″ lens, the lens is advanced 3″ per degree of enlargement; a 6″ lens advances 6″ per degree of enlargement or twice the distance of the 3″ lens; and a 9″ lens three times the distance required for a 3″ lens. In the case of the negative distances we find for a 3X enlargement, using a 3″ lens, the negative distance is 4″; for a 6″ lens the negative distance is 8″ or twice that of the 3″ lens; and for a 9″ lens it is 12″ or three times that of the 3″ lens. Considering any other degree

of enlargement and applying the same comparison, we find the same ratio exists; namely, the ratio between the enlarging distances for any two lenses is the same as the ratio between the focal lengths of the two lenses, as noted above.

Let us consider the enlarging distances given below for a 3, 6 and 9″ lens, taken from the tables that are published in most any book on enlarging.

DISTANCES WHEN ENLARGING

Focus of Lens, Ins.	TIMES OF ENLARGEMENT							
	1	2	3	4	5	6	7	8
	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.
3	6	9	12	15	18	21	24	27 easel distance
	6	4 1/2	4	3 3/4	3 3/5	3 1/2	3 3/7	3 3/8 negative distance
6	12	18	24	30	36	42	48	54 easel distance
	12	9	8	7 1/2	7 1/5	7	6 6/7	6¾ negative distance
9	18	27	36	45	54	63	72	81 easel distance
	18	13 1/2	12	11 1/4	10 4/5	10 1/2	10 2/7	10 1/8 negative distance

The above values are only relative and are not to be interpreted as actual distances based on the equiv. foci of the lenses considered, unless the lenses listed actually have 3, 6 and 9″ equiv. foci respectively.

The Cam. If we apply a cam construction for a 6 or 9″ lens based on the design for a 3″ lens it is apparent from the foregoing that the dimensions of the cam will need to be altered according to the ratio existing between the 3″ and the 6 or 9″ lenses; and this would involve the building of a cam much too large for practical construction. As an example, suppose we are using a 9″ lens and desire to make a cam producing a maximum enlargement of 6X from a 5 x 7″ negative. If 9″ represents the equiv. focus of the lens, the negative distance for a 6X enlargement would be 10 1/2″ and without even concerning ourselves with the diameter

of the base circle on which the 9″ cam would be constructed, we find the cam would be over 20″ in diameter, which, although of possible construction, is impracticable. The best plan to follow in dealing with cams for the making of enlargements from 5 x 7 negatives is to employ the 3″ or $3\frac{1}{2}$″ cam described and work out a device whereby the movement imparted to the negative carrier by the small cam may be stepped up to meet the conditions demanded of the longer focus lens. This stepping up device could be made of a lever arrangement or a rack and pinion movement *interposed* between the small cam and the negative carrier. The ratio of this stepping up device must be exactly that existing between the short lens and the long lens; i. e., if the relative focal lengths of the two lenses are 3 and 9″ and the ratio between their equiv. focal lengths is 1–3, then the stepping up ratio must be 1–3. Or to state it another way, the movement of the 3″ cam must be magnified before it reaches the negative carrier an amount equal to the ratio existing between the 3″ lens and the lens to be employed with the large negatives.

It is not within the province of this monograph to give working instructions for building an enlarger for use with large negatives, but the reader can get the fundamentals for the design of such an apparatus from the information just given. Not only would it be necessary to alter the dimensions of the main base but also to alter the size of the negative carrier, the lamp housing, etc. The construction of a large apparatus would also be confined in all probability to a projection printer with independent easel. In this connection it is also to be noted that when the rack and pinion mechanism is altered to meet the conditions required by a longer focal length lens, the cam driving mechanism must also be changed accordingly.

Cam Design. Where a cam must be designed and developed to fit a particular lens, the following method is advised. The rack and pinion movement automatically adjusts the distance between the easel and the lens. The distance separating the negative and the lens must be altered simultaneously with the changes in the easel distance. This is accomplished by the train of

gears actuated by the rack and pinion mechanism. The gear reduction is such that the movement of the large bevel gear, to which is attached the cam plate, is 1/10th of the movement of the small pinion engaging with the rack. In other words if the small pinion moves through a complete revolution or 360° of arc, the large bevel gear wheel moves through 360°/10, or 36°.

Let a be the length of arc through which the small pinion turns; r the radius of the pinion; and $180/\pi$ the factor converting arc into degrees; then A_1, the angle through which the small pinion turns, is

$$A_1 = \frac{a}{r} \times \frac{180}{\pi} \qquad (1)$$

For the large bevel gear, the angle is

$$A_2 = \frac{a}{r} \times \frac{180}{\pi} \times \frac{1}{10} \qquad (2)$$

Taking the case described in the text where the 3½″ lens has an equiv. focus of 3.63″ and the radius r equals ½″ and substituting in equation (2)

$$A_2 = \frac{3.63''}{0.5''} \times \frac{180}{\pi} \times \frac{1}{10} = 41.507^\circ$$

41.507° is the number of degrees the large bevel gear wheel turns through while the pinion is turning through $1\frac{1}{6.43}$ revolutions or the distance necessary to advance the lens one equiv. focal length (3.63″) from the easel. In the case of the 3″ lens having an equiv. focus of 2.874″, we get

$$A_2 = \frac{2.874''}{0.5''} \times \frac{180}{\pi} \times \frac{1}{10} = 32.933^\circ$$

In order to develop a cam we first select a suitable base circle on which to erect the drawing; and from experience a base circle of 4″ diameter has been found convenient to work with for lenses between 3 and 4″ focus. Having decided upon the diameter of the base circle, we next determine the length of the chord which is subtended by the angle A_2 in equation (2) which the 4″ circle, attached to the large bevel gear, turns through

when the pinion advances the lens 3.63″, or one focal length from the easel. We found above that for a lens of 3.63″ equiv. focus $A_2 = 41.597°$; and for a lens of 2.874″ equiv. focus $A_2 = 32.933°$. These angles and their corresponding chords are now looked up in tables giving chord lengths for circles of unity radius; or if tables are not handy the chord lengths may be computed quite readily from the formula: chord = diameter of base circle multiplied by sin $\frac{1}{2}A_2$. The length of the chord on a base circle of 2″ radius corresponding to 41.957° is found to be 1.43″ and for 32.933° it is 1.134″. That is, each time the pinion is turned through $1\frac{1}{6.32}$ revolutions, or the linear distance necessary to advance the auxiliary base one focal length of 3.68″, the base circle turns through an angle whose chord is 1.43″; and for a lens of 2.874″ focus, the chord is 1.134″. To obtain the chord length for any other focus it is only necessary to replace a in equation (2) by the value representing the focus of the lens to be used. Equation (2) reduced to its simplest terms is

$$A_2 = a \times 11.459°.$$

The factor 11.459° multiplied by any equiv. focal length gives the angle through which the base circle turns for each degree of enlargement. This simple formula holds good, however, only so long as the radius of the pinion remains ½″ and the gear reduction between the pinion and the large bevel gear remains 1–10.

Development of the Cam. The first step is to draw accurately a 4″ circle (see Fig. T) on a sheet of drawing paper or bristol board. The radius $O–D^1$ is drawn and extended as OD^1E. A pair of drafting dividers are now set for the distance 1.43″ and this distance stepped off around the circumference of the base circle, starting at D^1, eight times, because the apparatus has been designed to give a maximum enlargement of 8X. These eight divisions are D^1, D^2, D^3 . . . D^8.

It is necessary at this point to derive another formula before the development of the cam may be completed. We already know the rule for finding the distance of the negative from the lens for any degree of enlarge-

ment. It is: $\frac{a}{n} + a$, where a is the equivalent focus of the lens and n the degree of enlargement. These distances must now be combined with distances measured on radii of the cam in such a way as to make the cam function correctly. The simplest case to consider first is where the enlargement is the same size as the original. From the formula just given, negative distance = $\frac{3.63''}{1} + 3.63'' = 7.26''$. Suppose we start with one degree of enlargement, or where the negative distance is conjugate with the easel distance. The base circle of the cam is 4″ in diameter; therefore, the center of the cam is 2″ in advance of the distance just found. If we now rack out the auxiliary base we find the distance between the lens and the easel increases but no change takes place in the negative distance because the cam is still a circle. Next suppose we move the auxiliary base out until the distance between the lens and easel corresponds to a 2X enlargement. The negative must be pushed away from the periphery of the base circle of the cam a sufficient distance to satisfy the above formula for negative distance, which, for a 2X enlargement would be $\frac{3.63''}{2} + 3.63'' = 5.445''$. But as the cam is still a circle, its true radius is $7.26'' - 5.445''$ or 1.815″ too short; or the particular radius which is in contact with the stud on the negative carrier is 1.815″ plus the radius of the base circle, which gives as the total distance 3.815″. In other words, the distance from the center of the cam O, Fig. T, to the point on the periphery of the cam corresponding to a 2X enlargement should be 3.815″. In a like manner the distance for 3, 4 . . . 8 degrees of enlargement may be computed. Expressed as a formula it takes the following form:

$$R = (a + \text{radius of cam circle}) - \frac{a}{n}$$

where R is the radii of the cam for any degree of enlargement, a the equiv. focus, and n the degree of enlargement. For example, to find R for a 2X enlargement:

$$R = (3.63 + 2'') - \frac{3.63''}{2}$$
$$= 5.63'' - 1.815''$$
$$= 3.815''$$

N.B. The term (a + radius of cam circle) remains constant throughout the computation for various values of R.

See the Table of Radii. It now becomes an easy matter to develop the contour of the cam. The eight radii corresponding to the eight primary divisions of the cam are first computed from the formula just given. These distances are tabulated in the accompanying table and are shown in bold-faced type.

If we were to connect these points by straight lines we should obtain a very broken curve representing the contour of the cam; and as the end of each radius touched the stud on the negative carrier the negative distance for that particular degree of enlargement would be correct, but not so for intermediate points. For this reason we must compute enough points so when a contour curve is drawn through them a smooth curve is produced which makes the negative distance correct no matter what point on the periphery the cam is touching the stud attached to the negative carrier. It is to be noted from this tabulation the greatest change in the contour of the cam takes place in the lower degrees of enlargement; i. e., the lengths of the radii of the cam increase most rapidly in the smaller degrees of enlargement. Because of this it is desirable to obtain quite a few points between the first two or three primary divisions of the cam in order to draw a very smooth curve. Points corresponding to each 10th degree of enlargement up to 2.5 degrees of enlargement and by quarters for the balance of the base circle will produce a very smooth curve. These values for R for the 3 and $3\frac{1}{2}''$ cams are given in the accompanying table.

Having computed all the values for R we may now complete the layout of the cam. With O, Fig. T, as a center draw the arc EFG. Divide the sector EF up into 10 equal parts, and FG, which is just one-half of EF into 5 parts. Draw partial radii through these

points as indicated by 1.1, 1.2 . . . 2.5 which represent degrees of enlargement or fractions thereof. The balance of the primary divisions are divided into quarters as indicated by 2.75, 3.0 . . . 8.0.

Referring now to the table giving the lengths of these radii, we measure these distances, for each degree or fraction of a degree of enlargement, on the corresponding radii of the drawing, making all measurements from the outside edge of the base circle, first deducting 2, the radius of the base circle, from the values in the table. The distances given have been computed for the total length from the center of the base circle to the periphery, but more accurate measurements are possible by making them from the outside edge of the base circle; therefore it is necessary to subtract 2 from each of the values given in the table. A diagonal scale, divided into 10ths and 100ths of an inch will be found convenient for this purpose. Mark each point with a dot, and inclose it in a small circle for ready identification. When all the points have been laid off, the curve may be drawn through them, starting at D^1.

The foregoing method of developing a cam has been confined to a 3½″ cam. The same procedure is to be followed, however, for the 3″ cam, substituting the 3″ cam values for the 3½″ values whenever necessary. A lens of any other equiv. focus may be utilized but in this case it will be necessary to work out the values for R, the cam radii, from the formula given. When checking up the drawing in Fig. T, the measurements should be made from the outside edge of the base circle to the outside edge of the contour of the cam. The 3½″ cam is indicated by a heavy outline, and the points locating the curve inclosed by large circles; the 3″ cam is indicated by a light outline and by small circles.

CHESTER A. KOTTERMAN

TABLE OF RADII FOR 3 AND 3½" CAMS

n	R for 3" cam $.a = 2.874''$	R for 3½" cam $.a = 3.63''$
1.0	**2.00"**	**2.00"**
1.1	2.26	2.33
1.2	2.48	2.61
1.3	2.66	2.48
1.4	2.82	3.04
1.5	2.96	3.21
1.6	3.08	3.36
1.7	3.18	3.50
1.8	3.28	3.62
1.9	3.36	3.72
2.0	**3.44**	**3.88**
2.1	3.51	3.90
2.2	3.57	3.98
2.3	3.62	4.05
2.4	3.67	4.12
2.50	3.72	4.18
2.75	3.83	4.31
3.00	**3.92**	**4.42**
3.25	3.99	4.51
3.50	4.05	4.59
3.75	4.11	4.66
4.00	**4.15**	**4.72**
4.25	4.20	4.78
4.50	4.24	4.82
4.75	4.27	4.86
5.00	**4.30**	**4.90**
5.25	4.33	4.94
5.50	4.35	4.97
5.75	4.37	5.00
6.00	**4.39**	**5.02**
6.25	4.41	5.05
6.50	4.43	5.07
6.75	4.45	5.09
7.00	**4.46**	**5.11**
7.25	4.48	5.13
7.50	4.49	5.15
7.75	4.50	5.16
8.00	**4.51**	**5.18**

Notes and Comment

Amidol Tank Developer. In reply to a request for a reliable formula for an amidol tank developer, G. Gennert, of New York, importer of the well known Hauff developers, sends me the following formula, as used by professional finishers. It gives clean, snappy negatives and will retain its working qualities for at least a week. Dissolve 15 ounces sodium sulphite (cryst.) and $1\frac{1}{2}$ drams sodium bisulphite in 15 gallons of water, adding 23 grains potassium bromide. When complete solution is obtained, add $3\frac{3}{4}$ ounces of Amidol-Hauff and the developer is ready for use.

Turner-Reich Lenses, the Pancratic Telephoto, Corona Cameras and the new Radar F:4.5 anastigmat are described and illustrated in the 1923 catalogue issued by the Gundlach-Manhattan Optical Co., Rochester, N. Y. Two "soft-focus" lenses made by this firm are worth noting: the Hyperion Diffusion Portrait Lens F:4, a convertible with single combinations of F:5.6 and F:11 offering choice of 3 focal lengths, and the Achromatic Meniscus F:6, offering a flat-field soft-focus lens of unusual focal length at extremely moderate prices.

Propaganda Films, illustrating the industrial resources of Sweden, are being sent out to foreign countries by the Board of Trade of the Swedish Government. This is, I believe, the first international use of motion pictures by a national government for the purpose of stimulating foreign business.

Reproduction of portrait made by
an amateur with a Raylo Camera

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Stereophotography

Perfect photographic records. This, in three words, is the unique accomplishment of stereoscopic photography or stereophotography as it is called today. The three words mean just what they say. In the stereophotograph we have the perfect, i. e. complete representation of the object photographed, as it appeared to the eyes when the record was made. Not the partial and incomplete record given by the ordinary, single-lens camera in general use, but a real, honest-to-goodness, height, breadth and depth reproduction, which, when seen for the first time, amazes those who have never before come into touch with this sort of photograph. The ordinary flat-print photograph, made with one lens, gives us the subject as it would appear if viewed with one eye only: it cannot do otherwise. The stereophotograph, which is a photograph combining the two slightly different picture images obtained by photographing the subject with two lenses separated by the distance between the two eyes with which we ourselves see it, gives us a complete and truthful record of the subject as we see it—with two eyes. There can be no comparison between the two records. No other photographic method can give the marvellous illusion of reality, the depth, roundness, relief and perspective effects which constitute the outstanding features of the stereophotograph. It is as

if we viewed the subject itself, so perfect is its realism. Especially is this so if we view a color-stereograph, such as can be produced by the Autochrome method described on later pages, for then we have not only the mass, lighting and perspective, but also the color of the subject, reproduced with all the unapproachable fidelity of the photographic process. Such a method of photography is surely of special interest to the readers of THE PHOTO-MINIATURE and well worthy of their careful consideration.

The "how" and "why" or theory and practice of stereophotography are very simple and as interesting as they are simple. The method offers no difficulty to anyone who understands the handling of the ordinary hand camera. In this discussion of the subject I may seem to go into minute detail; but this should not mislead the reader into thinking that there is anything mysterious or difficult about it, my intention being to enable the reader to realize that stereophotography is merely an additional method of pictorial representation, by which he can obtain better pictures than the single-lens camera can give him.

The Theory of It. When we look with one eye at any solid object, we perceive it in two dimensions only, viz., its length and breadth. The third dimension, i. e., its thickness, depth, solidity, or relief, escapes us. Test this by looking with one eye centrally at the face of a cube or an ordinary round bottle. Similarly, looking with one eye at several solid objects in a group or scene, we are unable to perceive their separation by planes of distance or their relative position in space with regard to each other. Thus near and far objects appear, as in a picture, to be flat and piled up or pasted against each other, instead of standing out separately in relief as they actually do in the group or scene. It is true that, by the association of ideas, by our experience of differences in the size and shape of objects, and the illumination or light and shade effects, the brain tells us that the cube has depth and solidity, that the bottle has thickness and roundness, and that the several objects in the group or scene are separated by planes of distance. But the fact remains that this third dimen-

sion is not perceived by normal, unaided monocular vision.

Binocular Vision. If, however, we look with our two eyes at a solid object or group of objects, as we normally observe them, the third dimension is added, and we actually perceive the depth, solidity, and natural relief of the objects, together with their relative positions and separation by planes of distance. This is the effect of binocular or stereoscopic vision, the word stereoscopic being derived from two Greek words: *stereos*, solid, and *scopeo*, I view. The explanation of this difference between monocular and binocular vision is simple. As the eyes are set horizontally in the head and separated by a distance of about $2\frac{1}{2}$ inches, so our eyes see two distinct and slightly different pictures of every object to which they are directed, the object being viewed from two different points. Thus the left eye sees more of the left side of the object and the right eye sees more of the right side of the object. These two similar but slightly different picture-images are blended or fused in the brain to form a single record of the subject in all its three dimensions, so that, in addition to perceiving the length and breadth of objects, we can estimate their depth or solidity, and appreciate their separation in space.

The Stereoscopic Method. Stereophotography, then, is simply a method of photography which follows the natural way of seeing things with two eyes, and which therefore gives us a three-dimensional record of what we see, as the eyes see it. The stereo camera is fitted with two lenses, set horizontally side by side and separated as our eyes are. Such a camera naturally gives two pictures of the subject, each from a slightly different viewpoint because of the separation of the lenses. Placed side by side in the form of positives on glass or paper, these two slightly dissimilar pictures are viewed in a stereoscope or viewing box, in which the two views are merged or combined to form a single record of the subject, just as the two retinal images are blended or fused in the brain, with the result that we obtain in the stereophotograph an exact reproduction of the subject—as the eyes saw it when the record was made.

Lens Separation. On your mother's or grandmother's table in the old parlor was, years ago, the stereoscope—an object of childish awe—with its collection of paper-prints (of course on cardboard mounts) of "Niagara in Winter," "Leaning Tower of Pisa," "Pyramids and Sphinx" and other world-known views. The pictures, set between the wire brackets of the cross-arm of the stereoscope, were moved back and forth until they came into correct focus when viewed through the lenses of the stereoscope—whereupon they fused into one three-dimensional image—"stereo-d," we say, today, for short. Those first pictures of this type were made with cameras having lens-separations of 3 to 3½ inches (usually the latter figure) and this separation is used today on American-made stereoscopic cameras. The pictures, themselves, are 3⅛ inches wide and 3³⁄₁₆ inches high. This size is the American standard. Overseas, the standard size is radically different—there are, in fact, *two* standard sizes. The smaller, and more popular, is, over all, 45 x 107 mm. (1¾ x 4¼ inches); the larger, over all, is 6 x 13 cm. (2⅜ x 5⅛ inches). The American standard size is not manufactured in Europe; the European standard sizes are not manufactured in America—an unfortunate situation, as both sizes have their good points. The principal American makers, however, market film-packs for the smaller European standard size (45 x 107 mm.), which has done much to add to the popularity of that size in this country.

As a matter of sheer optical fact, some eye-strain is required to view any stereophotograph taken with lenses separated more than one-quarter inch (approximately) more or less than the separation of your eyes. In the case of a normal man, the eye-separation is (for all practical purposes) 2½ inches, so the stereophotographs which are most comfortable for the eyes are those made with cameras having lens separations between 2¼ and 2¾ inches. With a properly-balanced stereoscope, however, having lenses suited in both focal length and separation to the size picture being viewed, any of the standard sizes make acceptable pictures. Naturally the American standard size camera,

being larger than the European standard sizes, is equipped with lenses of greater focal length and, consequently, produces larger images than the imported instruments—a point very much in favor of the large size and rapidly becoming more so as the value of stereophotography in commercial work is becoming better understood.

Viewing the Picture. Naturally, since two pictures are taken, as has been described, it follows that both pictures must be viewed at the same time to produce the three-dimensional effect which is the purpose of stereophotography. Either the old-fashioned stereoscope or the modern viewing box is available. To give the best results, the stereoscope (or viewing box), for the viewing box is merely the most modern form of the stereoscope) should be equipped with lenses of approximately the same focal length as the lenses used in taking the pictures to be viewed. This is not such a task as might at first be thought, for each of the three standard size cameras (American and European) uses lenses of approximately standard focal length and any reasonable deviation from this length is readily taken care of by the focusing device of the stereoscope. The average stereoscope likewise has standard separation—3 to 3½ inches for the American standard size; 2⅜ to 2⅝ inches (58 mm. to 65 mm.) for the smaller European standard size; and 2½ to 2⅞ inches (62 to 72 mm.) for the larger European standard size. Thus everything is arranged to duplicate in viewing (as far as duplication be possible) those optical conditions under which were made the original exposures for the pictures to be viewed.

The mind, accustomed to making one composite image from the two actual and different images seen by the two eyes, does the same thing automatically with the two pictures of the stereoscopic print and—behold! we have, through the slightly different viewpoints and slightly different images, in the superposition (optically) of the two images, the actual reproduction of perspective—*not* because a three-dimensional picture has actually been produced (for this has not been done) but because the mind has received all that *it*

needs to visualize perspective. *Mentally*, the stereophotograph *creates* perspective.

What Makes a Good Stereophotograph. Because the stereophotograph has, as its basis, perspective as the human eyes visualize it, this type of photography makes a marked increase in the number of available photographic subjects. Not every scene makes a good ordinary (single-lens) picture. In many cases the photographer views a scene that in color, lighting, perspective and mass combined is pictorially effective. When reduced to a one-plane monochrome, as in the ordinary print, much of the effectiveness and beauty have gone because, between scene and print, both color and perspective have disappeared. The stereophotograph restores perspective, leaving color, alone, lacking in depicting the scene as it actually existed when exposure was made. The use of the autochrome plate naturally restores the element of color so that the stereo-autochrome actually reproduces all the elements—color, lighting, mass and perspective—that made up the beauty of the scene when photographed.

Briefly, then: any scene that in lighting, mass and perspective is effective to the eye will make an acceptable stereophotograph.

Foreground Necessary. In taking into account the making of a stereophotograph,there is one point that it is impossible to emphasize too strongly: an acceptable stereophotograph *must* have a strongly-accented foreground or object in the foreground—foliage, a human figure, portion of a building, or something of the kind. Some such object is necessary to bring out perspective fully. So necessary, in fact, that a stereophotograph without at least one strongly-emphasized foreground object will be flat and entirely uninteresting. This is particularly noticeable in such pictures as shore-views in which there are neither waves, rocks nor vessels in the immediate foreground—beautiful as the eyes see the view, but miserably flat and unimpressive in the stereoscope. Incidentally, it may be added that the stereophotograph (for reasons explained fully, later, herein) does not permit of the making of "fuzzy "prints.

Reproduction of a 45 x 107 mm. stereograph, made with a Richard Verascope, same size as the original print.

Commercial Possibilities. Business has just begun to appreciate the fact that a distinct field is covered by stereophotography. One general commercial aspect of the work will be taken up in some detail in an addendum hereto, because of its presentation of problems of technique that are largely based on mathematical optics. Suffice it to say, now, that the same principles which make possible a three-dimensional photograph of an outdoor scene likewise make possible a three-dimensional photograph of a piece of jewelry a chair, a frock or a motor car. So much for the general theory of stereophotography.

Problems in Practice. In the actual practice of stereophotography, four main divisions of the field present themselves as problems of equipment or manipulation. In order, they are: (1)—the camera, with its mechanical and optical equipment; (2)—the negative, including details of choice of emulsion, exposure and development; (3)—printing the positive, including the all important matter of transposition and the questions involved in making positive transparencies on glass (most satisfactory of present day methods) or on film, or ordinary prints on paper; and, (4)—viewing, including types of stereoscopes and viewing boxes and the handling of them.

This is, of course, the same list of problems that is presented in considering the practice of any kind of photography—*plus* the problems that arise from the use of two lenses, instead of one. The practice of stereophotography is not any more difficult than the practice of ordinary, single-lens photography; nor is the additional slight tediousness incident to lengthening of the printing process by transposition a drawback worthy of serious consideration. The results, where completeness of record is desirable, are so much more satisfactory than in single-lens photography, that with the simplification of modern photographic methods and equipment it seems reasonable to suppose that stereophotography will continue to make more and more converts as time passes.

The Camera. In general, the stereoscopic camera consists of a box holding, in its front wall, two lenses,

and in its back wall a sensitive plate or film; somewhere between lenses and plate a device to regulate the exposure (the shutter); and a division of the box, from front to back, midway between the lenses. (This division prevents the right edge of the left image from overlapping the left edge of the right image, inside the camera and on the plate.) This is, of course, nothing more or less than the simplest form of ordinary camera, except for the additional lens and the box division.

Camera Types. As in ordinary cameras, there are two general types of stereoscopic cameras—box form and collapsible. Each has its strong points—likewise its weak points. Each type has its ardent advocates and its violent opponents.

The usual box form stereoscopic cameras are of metal construction to avoid warping due to temperature and humidity variations. Most instruments of this type have been non-focusing up to the time of the war, but, since the war, focusing devices have been added to practically all the higher class box form cameras. All of these instruments are made abroad (the American made stereoscopic cameras are both of bellows-type construction) and are of the smaller European standard size, for the most part, carrying lenses of such short focal lengths that everything from about twelve feet onward is in visually sharp focus, even at a lens aperture of F/4.5, making focusing devices really unnecessary, generally speaking.

Two models of box form type, of German manufacture, are fitted with a metal light chamber increasing in size from lens board to camera back, giving to the instruments much the appearance of a pair of binoculars. For the most part, however, the box form stereoscopic cameras are of rigid, rectangular construction throughout, and will stand much hard wear and jolting—which is not true of all the collapsible type instruments.

The collapsible type is, of course, based on the use of some form of bellows, supporting arms and focusing device. In the small instruments of this type, imported from Europe, there is naturally some sacrifice of rigidity to permit the use of a bellows. And rigidity

is most important because the rigid camera front assures both lenses being *in the same plane* and producing sharp images. *A blurred image is fatal in stereophotography.* The addition of a rising front to a a stereoscopic camera naturally detracts from the rigidity of a collapsible type instrument, but has no appreciable effect on a box form instrument—a point that can not be overlooked in buying a camera, unless the purchaser is willing to take a chance.

American Stereo Cameras. Only two stereoscopic cameras of American manufacture are now on the market—both Eastman products. The Stereo Kodak comes equipped with F/7.7 Kodak anastigmat lenses and with a shutter giving exposures of 1/25, 1/50 and 1/100 second, in addition to "time" and "bulb" exposures. There is a rising front and focusing is by scale or rack and pinion movement. The instrument uses a standard size of film, obtainable everywhere, and is unquestionably the most popular stereo camera on the American market. It takes pictures of the standard American size—each 3⅛ by 3³/₁₆ inches.

The Stereo Auto Graflex is the "siege gun" of the clan. It comes equipped with a pair of F/6.3 anastigmats of 6¼ inch focal length; has ample rising front; the Graflex focal plane shutter; and takes 5 x 7 plates or films. Each picture is, therefore, 3³/₁₆ inches wide, but 5 inches high—thus allowing for cutting off unnecessary foreground or sky. A peculiarity of this instrument is the incorporation, in the focusing hood, of a pair of prisms, making virtually a stereoscope of the hood, so that in focusing only one image is observed—just as in viewing the finished picture.

European Cameras. Unfortunately, the American line of stereoscopic cameras ends with the two already mentioned, and if the operator desires to use the smaller sizes of instruments he must, of necessity, purchase a camera made in Europe. Before the war, the European stereoscopic cameras had gained a fairly good foothold in America. During the war, importation was almost stopped. Today, most of the pre-war models are again available—practically all of them with improvements in manufacture.

From France comes the Verascope, of Richard—probably best known of all European makes. It is of the non-focusing metal box form and, in its complete model, carries all possible equipment for all kinds of stereoscopic work. The 6 x 13 cm. model now comes with focusing device—a post-war development.

The Gaumont Spido, Stereo Bloc-Notes, Verographe, Ontoscope and Nil Melior are other French instruments now finding their way on the American market—all quite similar in general instrumental capability and all of the rigid box form type; some with focusing device—some without it. Both European standard sizes can be had in most of the instruments named. All of them are equipped for plates or filmpacks, or both, the Verascope being the only one for which rollfilm holders can be obtained.

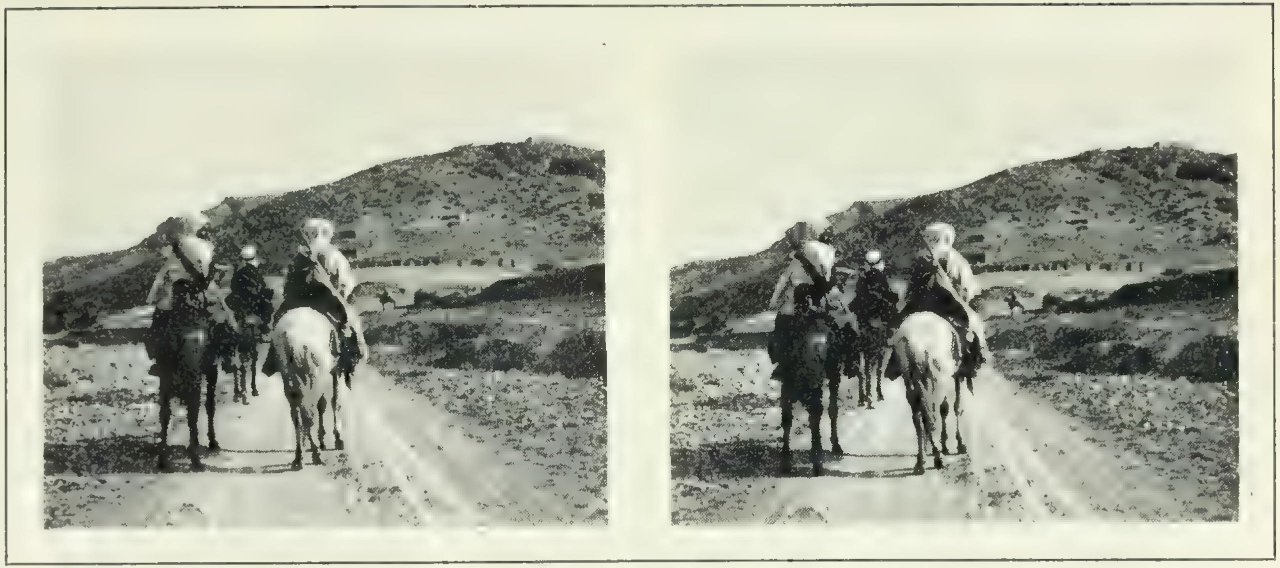
Of the German instruments on this market, the Polyscope (in both European standard sizes), the Stereolette and Stereofix, of the Ica line, are favorably known. The Polyscope is of rigid box form construction with focusing-front; the Stereolette is of collapsible type, with separate bellows for each lens; and the Stereofix is of fixed focus construction. The Voightlander reflecting stereoscope (in the smaller size) and Stereoflectoscope; the Goerz Stereo-Tenax (of the well-known Tenax construction); the Duchessa-Stereo (in the smaller size), Contessa-Nettel Stereax (in only the larger European standard size) and Steroco—the Stereax a focal-plane shutter instrument of abnormal bellows capacity and unique focusing adjustment, and the Steroco the lightest weight, fixed focus stereoscopic camera made; the Ernemann Bob XV, with self erecting front and strictly a rollfilm model (of the smaller European standard size) with the Heidoscope:—all these German made stereoscopic cameras are imported into America today as regularly established lines. Catalogues of the various importers give detailed descriptions of the instruments and accessories. All of those mentioned have been tried out in actual use and have proved sound in principle and in construction. With each make of camera is a line of accessories—printing frame, viewing box, developing tank and

various other devices, all of value in making easier the taking of stereoscopic pictures.

Shutters. In all of these cameras, American and European, five types of shutter are to be found: the T-B type with added automatic speeds of 1/25, 1/50 and 1/100 second; the guillotine type; the Compound type; the Compur type; and the focal plane type. Each of these shutters will do certain things and each has its limitations. Certain of these limitations are of far more importance in stereophotography than when the same limitations show up in ordinary photography. This will be pointed out as the various shutter-types are discussed in some detail.

The T-B type of shutter, with added automatic speeds of 1/25, 1/50 and 1/100 second will be found on the Stereo Kodak, the Ica Stereofix, Contessa-Nettel Steroco and other not-so-well-known stereoscopic cameras. It is a fair shutter. In most cases the marked 1/25 second will prove to be about an actual 1/20 second; the 1/50 and 1/100 second each about 1/40 second in reality. The use of the "B" marking for slow instantaneous speeds (a good 1/2 to 1/8 second is always possible in this way) is of great importance and in the hands of a skilled operator a shutter of this type can produce thoroughly satisfactory work. With this shutter, it is a mistake to try to stop rapid motion nearer the camera than fifty feet—very rapid motion nearer than one hundred feet.

The guillotine type shutter is found only in instruments of French make, having been discarded by all other makers years ago. Tests have proved with scientific accuracy that this type of shutter is exactly fifty per cent. efficient in light-transmission. For example: if an exposure of 1/10 second is made with a guillotine shutter, the light transmitted by that same lens in 1/10 second without any shutter would be just twice as great as the light transmitted through the guillotine shutter. The guillotine type shutter has two good points, as far as stereoscopic photography is concerned. It is exceedingly accurate as to timing and, therefore, is well fitted to handle problems of stopping motion. It is, too, of exceedingly simple construction and quite durable—



Reproduction, same size as original, of 6 x 13 cm. stereograph, made with the Richard Verascope.

not likely to "go bad" when far from an expert shutter-repairer.

The Compound shutter is so well-known as to require merely passing reference as the best between-lens shutter heretofore obtainable. In the smaller sizes of stereoscopic cameras, the Compound shutter gives instantaneous speeds up to 1/300 second—ample to handle any motion-stopping problem that may present itself.

The Compound shutter has had one weak point—it has depended for its timing of instantaneous speeds on the action of an air-cylinder. This is, at best, problematical. The Compur shutter, which has recently made its appearance, may be non-technically described as a near-Compound shutter operated (as to timing) by a set of gear-wheels instead of by an air-cylinder. The theory of the Compur shutter is right because it substitutes for the problematic action of an air-cylinder the positive action of a set of gear-wheels. Just after the war, Compur shutters reaching this country were made of inferior material and came in for severe censure. That condition has been entirely remedied and we can expect to see the Compur shutter take its place as the best obtainable between-lens shutter, from this time on. It has the same range of shutter-speeds as the Compound.

The Stereo Auto Graflex, Mentor Stereo and Voightlander reflecting stereoscopic camera, of those available in this country, are equipped with focal-plane shutters as is the Nettel-Stereax. The Graflex naturally carries the multi-slit Graflex shutter, while the European instruments carry the usual European type, with only one slit which can be varied in width for different exposure times. It is now well established that the focal-plane shutter, when properly constructed, is the most efficient, as to transmission of light from lens to sensitive emulsion, that has ever been commercially practical.

The same excellencies that place the focal-plane shutter at the head of the list in single-lens-camera work, likewise are points of strength for the same type of shutter in stereoscopic work. As between the two kinds of photography, there is no difference in handling

the shutter. By reason of its high exposure speeds, the focal-plane shutter enables the operator to obtain unusual pictures of arrested motion; by reason of its efficiency (ability to pass light) at low exposure speeds, enables the operator to make pictures under unfavorable light conditions. The focal-plane shutter has, of course, the one objection of no automatic exposure speeds slower than an approximate 1/10 second. This is a distinct disadvantage for stereoscopic work because, for many types of subject, it is absolutely necessary to stop down to obtain detail and to give an exposure of 1/2 to 1/5 second. Correct handling of the "time" exposure mechanism will accomplish this, but in making such exposures great care must be taken to avoid vibration of the camera.

No piece of mechanism is called on to do, so continuously, for so many years, such accurate work as a high grade camera shutter, *without lubrication.* Oil is death to a camera shutter because it "gums the works." The shutter made of poor material can not stand this strain. A good shutter is worth all it costs, from the standpoint of freedom from worry and repairs, as well as from the standpoint of accuracy in rated shutter-speeds.

The market affords several devices to add automatic shutter-speeds to most types of shutters, by the use of air valves of various kinds. One such device consists of a valve set into the rubber tube running from an ordinary bulb to the shutter-trip. When the shutter is set on "bulb" the valve holds the shutter open for the indicated length of time, by permitting slow escapement of air from the valve cylinder. Another device of this kind holds a cable release for the indicated time, so that the release, in turn, holds the shutter (set on "bulb") open. These valves both work with indicated speeds of 3 seconds, 2 seconds, 1 second, 1/2, 1/4 and 1/8 second, thus adding a very desirable and, in fact, almost necessary range of speeds to most shutters. Both these valves are of British manufacture and are exceedingly moderate in cost.

Stopping Motion. Detail and sharpness are essential in a good stereophotograph. It is, therefore, sometimes convenient to know just how far to go, in making an

exposure, to be certain that motion of the principal objects has been stopped. Here is a simple formula for finding this:

Let D = Distance of principal object from lens, in inches. S = Speed of object in motion, inches per second. F = Focal length of lenses, in inches. E = Exposure necessary to stop motion.

It can be readily shown that $E = \frac{D}{S \times 200F}$ in which formula, movement of the *image* during exposure has been held to 1/200 inch which, in the average stereo-photograph seen through a stereoscope or viewing box, will be inappreciable. Should even this motion prove too much, however, when the positive print is viewed, the formula can be changed to allow for an image-movement of 1/300 inch or 1/400 inch by substituting, in the denominator of the formula, the figure 300, or 400, respectively, for the figure 200 in the formula as given. In this connection, the following table will allow rapid calculation of the general formula, as the table gives the number of inches per second (S, in the general formula) equivalent to various speeds usually expressed in miles per hour.

Mi. per hr.	Ins. per sec.	Mi. per hr.	Ins. per sec.
1	18	18	317
2	36	20	352
3	53	25	440
4	70	30	528
5	88	35	616
6	106	40	704
7	123	45	792
8	141	50	880
9	158	55	968
10	176	60	1056
11	194	65	1144
12	211	70	1232
13	229	75	1320
14	246	80	1408
15	264	90	1584
16	282	100	1760

In this connection, it must be recalled that the *image* of an object that is traveling at right angles to the line of vision moves three times as rapidly (for photographic purposes) as the *image* of the same object, if traveling at the same speed directly toward or away from the camera. And if the angle of motion is approximately forty-five degrees to the line of vision, the movement of the *image* is approximately one-half of the same motion when at right angles to the camera. For example, if an exposure of 1/300 second is required to stop motion of an automobile traveling directly across the field of view, the same machine, traveling at an angle of approximately forty-five degrees to the line of vision can be "stopped" with an exposure of 1/150 second or, traveling practically directly toward or away from the camera, can be "stopped" with an exposure of 1/100 second—the speed of the machine, in all three instances, being the same. Naturally, excessively rapid motion requires the use of the focal-plane shutter, but any ordinary moving object can be handled with the 1/300 second exposure limit of the Compound or Compur shutter to the entire satisfaction of the stereophotographer.

Lenses. Even more so than in other kinds of photography, the lens is the all important part of the stereoscopic camera. It *must be right.* Briefly, only one type of lens will answer requirements fully—the anastigmat. Even it must be chosen for the work in view. Manufacturers of modern stereoscopic cameras fully recognize this point and (with two minor exceptions) all stereoscopic cameras, both American and European, come with anastigmat equipment.

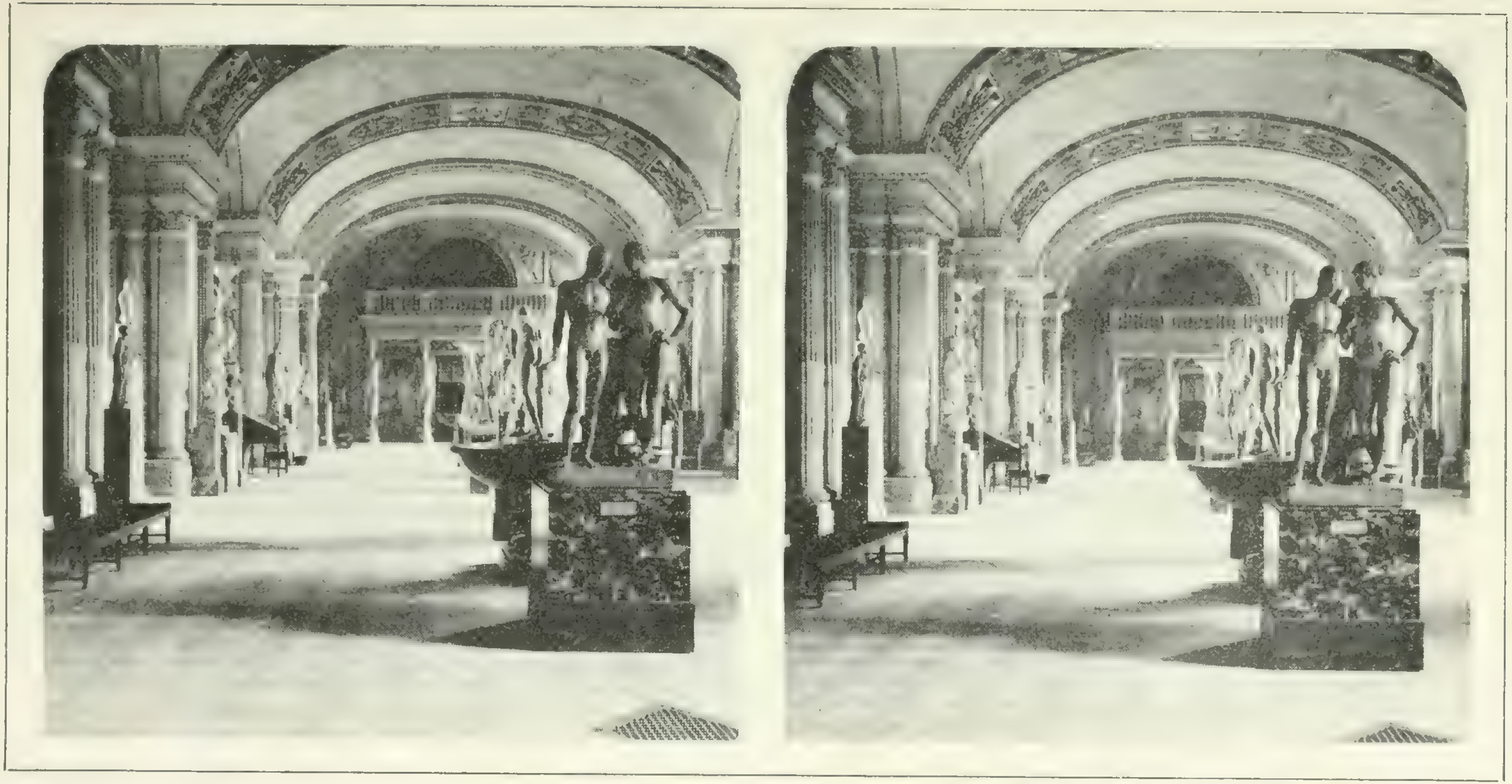
The reason for this fact is, in brief: detail *makes* the stereophotograph. The anastigmat lens gives the sharpest detail of any lens available. Hence: the anastigmat for stereophotography.

Matching Lenses. Just here it is entirely fitting that a trade custom imported from Europe (and practiced in the United States for all the traffic will bear, except in very few instances) be referred to. This is the "matching" of lenses for stereoscopic cameras—the selection of a pair of lenses of supposedly identical

focal-length. A rather stiff charge is generally made for such matching. Bluntly, any heavy charge is unfair. And for this reason: there need not be *exact* matching of focal lengths of lenses intended for ordinary use on a stereoscopic camera, and no manufacturer need charge more than a nominal fee for picking out two lenses of *approximately* the same focal-length. When tested by an optician, very few human eye pairs show both eyes exactly matched. And yet, the physical and mental organs of sight are so constructed that the normal human being sees approximately properly. So it is with stereoscopic pictures. The focal lengths of a pair of lenses may vary as much as ⅛ inch, in the American standard size camera, or 2 mm. in the European standard size instrument, without producing sufficient difference in the pictures to be noticeable when the positive is placed in the stereoscope. Thus, except for work demanding extreme exactness, a pair of actually "matched" lenses is unnecessary in stereophotography—likewise the matching charge. True, theoretically the perfect picture is produced by two perfectly matched lenses. Such a pair is exceedingly desirable. The point is, it is *not absolutely necessary.*

Lens Apertures and Reserve Power. In discussing, later herein, the matter of exposure for stereoscopic pictures, it will be made clear that, as a usual thing, slow instantaneous, or short time exposures will frequently be advisable. For such exposures, the modern anastigmat working at F/6.3 to F/6.8 is admirably fitted. Naturally, if one has an instrument equipped with F/4.5 lenses, there is a heavy reserve of light transmitting power available if necessary—but it is to be remembered that the stereoscopic camera has *two* lenses instead of one, so the additional expense of a lens working at F/4.5 over one working at F/6.3 or F/6.8 is doubled. The question of reserve speed, however, is not especially vital, for, as will hereafter be shown, it is advisable to use an aperture of F/11 or smaller for many stereophotographs.

The Soft-Focus Lens. In the field of single-lens photography, there has arisen, in recent years, the cult of the soft-focus lens and much that is artistic and



Reproduction, same size as original, of the American standard size stereoscopic photograph.

beautiful has been produced with lenses of that type. *Such lenses are absolutely taboo in stereophotography.* A stereoscopic picture must have detail down to the last possible degree if the three-dimensional effect is to be produced successfully. Detail, in the three-dimensional picture, is that upon which the eye instinctively seizes to gain its visualization of perspective. Consequently, if detail be absent—if there be but massed light and shadow—if there be not absolutely sharp outline of all objects in the picture—there is nothing out of which to form the one three-dimensional image. There is no "stereo". The modern anastigmat is, of course, the only kind of lens that gives the requisite sharp detail. Therefore, with no chance for beating round the bush, *the only type of lens suitable for stereophotography is the anastigmat.*

If all stereophotographs were taken with apertures of F/16 or smaller, then the single lens, such as the Brownie uses, would be acceptable. The rapid rectilinear would also then fill the bill more than nicely. But it is often necessary to use much larger apertures than even F/8—the limit of use of the average rectilinear. Volumes could be written on the general subject of lens-equipment for stereophotography, but, summed up, the entire story would be this: detail makes the stereophotograph. Therefore—the anastigmat lens, and *only* the anastigmat lens, is the proper lens for general stereoscopic photography. As to what particular lens to use—let experience guide. You know the lens with which you best like to work. Use lenses of that kind on your stereoscopic camera—the chances are you can obtain that equipment with little trouble. And you will be at home from the start with your old friends—*your* type of lens.

Chamber Division. It has been pointed out that to prevent overlapping of images produced by the two lenses of a stereoscopic camera, a division of the camera chamber, itself, is essential. In the different types of instrument, the division, itself, is naturally of different types. The box form instruments have an inbuilt, permanent division which, in most instruments, is approximately one-quarter inch wide. Some folding

type instruments have what amounts to a permanent division of the dark-chamber in the form of a separate bellows for each lens of the camera. Most of the collapsible type instruments, however, make use of a single bellows, with a curtain division, the curtain working on a roller in the rear of the dark-chamber. In some instruments, this curtain can be removed. so that the entire chamber can be used (with one lens of the camera centered and stopped down for detail) to take pictures of the "panoram" or panel type. This arrangement, however, is not especially common.

The Negative. All stereoscopic cameras (with perhaps the two exceptions of the Stereo Kodak and the Ernemann Bob XV, both of which are roll film models, only) come equipped with plateholders—either single or double. For most instruments of the better class, plate magazines, taking twelve plates at a time, each in a metal septum, can be obtained. (Incidentally, since the advent of cut film, the use of magazines has greatly increased. The Eastman Company markets a special magazine equipped to handle cut films only, which magazine is adapted to the Stereo Auto Graflex.) For the Richard Verascope, roll film holders are obtainable. For practically all cameras of the stereoscopic class, filmpack adapters are part of the regular equipment. Thus there is at hand, for the stereophotographer, the same wide variety of emulsions obtainable for the ordinary photographer.

Orthochromatism. In ordinary photography, the use of special orthochromatic emulsions has generally been confined to special cases in which monochromatic rendering of contrasting colors was desirable. In stereoscopic photography, there are two absolutely distinct sides to the matter of orthochromatism—and it is for you, the user, to decide, after considering both of the sides.

It must always be remembered that detail makes the stereophotograph. Detail is so much more essential in the makeup of the stereophotograph than of the ordinary picture that color values are not comparatively so essential in the monochrome stereophotograph as in the monochrome single-lens photograph. From one

viewpoint, then, the orthochromatic qualities of an emulsion do not count for as much in stereoscopic work as in work with a single-lens instrument.

Another factor bearing on this point is that, in general, the sky forms a far less important part of the average stereophotograph than of the average single-lens photograph. This is, of course, true because a good stereophotograph *must* have a strong foreground object –and except under unusual circumstances, strong foreground and a great deal of sky do not associate to advantage in one picture. If there are no clouds in the sky, the lack has no terror for the stereophotographer. He goes serenely on his way, confident that a "bald-headed" sky will not detract from his three-dimensional picture because of the fact of those three dimensions and the visualized perspective.

From the other standpoint, we are confronted with the indisputable fact that the orthochromatic emulsion gives more detail than the ordinary emulsion *in those cases* in which detail of form is based largely upon luminosity contrasts. And such cases are many. A very common example is that of a tree, standing against a background of hill—both green, but of different *shades*. The differentiation of the form of the tree from the background of the hill depends, in such a case, largely upon luminosity contrast—hence is better handled by an orthochromatic emulsion than by one not particularly color-sensitive. The best emulsion is, naturally, one which has some approach to orthochromatic balance—especially in its sensitiveness to the yellowish-green light of spring and autumn mornings and evenings, and of midwinter days in general. Such an emulsion adds surprisingly to the apparent "speed" of your outfit when you attempt to photograph out of doors before, say, nine o'clock in the morning or after four o'clock in the afternoon, in spring or autumn—or, for that matter, at any time of the day in the average winter of the United States, except the extreme south, where the yellow and green of the winter-time sunlight is not so pronounced. At such times, the actinic quality of sunlight is much poorer than in summer, and it is then that such emulsions as the Standard Orthonon plate or

Hammer D. C. Ortho show their peculiar value. There is also a direct color plate available for the stereophotographer in the autochrome. His plateholders must be of special thickness to take these plates, but such holders can be obtained for most of the cameras in the market.

Cut Film. The development, in recent years, of the use of cut film in stereoscopic work has been pronounced. There is much in its favor, as compared to plates, because of its extreme lightness of weight. At the same time, all of the standard types of emulsion —regular, portrait, super-speed, commercial panchromatic, commercial regular, commercial orthochromatic and process—can be obtained in all standard sizes. These various emulsions have a fineness of grain not obtainable in plates—another exceedingly desirable quality for stereoscopic work. Cut film can be handled in developing tanks and in the plate magazines and single plateholders with as much ease as plates, and its development is no more difficult. Frankly, the use of cut film in stereoscopic work is recommended.

Filmpacks. For some unknown reason, our American manufacturers, although making filmpacks for the smaller European standard size (45 x 107 mm.) have not seen fit to make filmpacks for the larger European standard size—6 x 13 cm. The Eastman filmpack emulsion leaves nothing to be desired, when properly handled. The Eastman pack is, of course, available for the Stereo Auto Graflex, but there, again, the use of cut film is to be preferred.

Plate Grain and Its Effects. The stereophotographer must contend with one emulsion factor which is not of great importance to the user of the single-lens camera, except in cases of unusual enlargement—grain of emulsion. In viewing stereoscopic pictures, the average stereoscope magnifies to such an extent that the picture is practically 8 x 10 inches, or even larger, in apparent size. Naturally, under such magnification, the gelatine grain and the silver grain of the emulsion are greatly magnified. It is, therefore, wise to select an emulsion for negative work that has as fine a grain as possible. (In discussing the printing of the stereoscopic positive,

it will be shown that a proper selection of positive plates practically eliminates the matter of emulsion grain in the *positive* plate; therefore grain in the *negative* plate is the important thing to eliminate as much as possible.) It is this matter of emulsion grain that is the great objection to the autochrome for stereophotography. The microscopically fine starch-grains of the autochrome plate are so greatly magnified in the viewing box that, without proper handling, they can spoil an otherwise beautiful autochrome.

Exposure. The exposure problem of the stereophotographer does not differ greatly from that of the worker with the single-lens camera. Granted that one uses the proper lenses to obtain sharp outline, *detail* is the one essential, so that both theory and practice emphasize these general exposure rules: (1) Stop down for detail. (2) Use the slowest shutter-speed that will stop motion in the subject photographed. (3) Give as full exposure as is possible under the circumstances—of course avoiding deliberate over-exposure.

Practical work with the stereoscopic camera shows that more successful pictures will result from the use of lens apertures ranging from F/8 to F/16 than from any other series of apertures. At the risk of becoming tiresome, it must be repeated that *detail* makes the stereophotograph—hence the practical value of the F/8, F/11 and F/16 openings.

The use of the slowest shutter speed that will satisfactorily stop motion is, of course, advisable—up to the limit of full exposure. In its turn, full exposure makes more certain the obtaining of detail in the positive or final print.

The following exposure-figures are merely suggestions, to be modified, of course, according to light conditions and emulsion used. The figures given will be found satisfactory for the Eastman filmpack, for ordinary sunlight or lightly-overcast sky. *Average landscape,*—1/25 sec. at F/11. *Ordinary street scene,*—1/25 sec. at F/8-F/16. *Rapid traffic,*—1/100 sec. at F/6.3-F/11. *Athletic events,*—1/250 sec. at F/4.5-F/6.8. *Autos, trains,* etc.,—1/250 sec. at F/4.5. *Beach and Water scenes,*—1/50 sec. at F/16-F/32. *Snow scenes,*—1/50

sec. at F/22-F/32. *Woodland scenes,*—1 to 30 sec. at F/8-F/11.

The use of some kind of exposure meter is recommended, because, by giving correct time to all exposures, the reader will save both work and cash in pursuit of his hobby. There is no royal road to correct exposure in stereophotography, any more than in ordinary photography. To be certain of a good result, one must "get it in the negative" and in stereophotography much more must be in the negative than in ordinary photography. The old theory of bringing out in the darkroom something that was not put into the negative at the time of exposure has been thoroughly discredited. It cannot be done. Nowhere is this more true than in stereophotography. Don't try.

Development. The usual technique of development fills every requirement of the stereophotographer—*if followed carefully.* Nothing essentially new is presented, as compared with the development of ordinary plates and films. There are, however, certain points worth considering.

The best negative for stereoscopic work is one that errs, if anything, toward thickness or density. This, once more, goes back to the necessity for detail in the stereoscopic print. (Do you notice how the whole theory and technique are built on that one thing?) Hence—*do not underdevelop.* If underdevelopment should, by accident, occur—intensify.

For the development of stereo negatives, any of the standard developers is satisfactory for plates and cut films. Pyro, Metol, Metol-Hydrochinon, Eikonogen—these and many others are used in stereoscopic work. One of the most-generally-satisfactory formulae obtainable is the well-known Ilford "P-S" developer, for either tank or tray. It is as follows: *Stock Pyro Solution:*—Potassium Metabisulphite, 100 grains; Pyro 1 ounce; Water (distilled) 10 ounces.

For Working Solution No. 1, take:—Stock Pyro solution, 2 ounces; Water, 18 ounces. For Working Solution No. 2, take:—Sodium Carbonate, 1 ounce; Sodium Sulphite, 1 ounce; Potassium Bromide, 20 grains; Water 20 ounces.

For development by tray, equal quantities of solutions Nos. 1 and 2 should be used. The time, at sixty-five degrees, will be found to be about three minutes.

For tank development, 5 ounces of solution No. 1, 2½ ounces of solution No. 2, and 4½ ounces of water, used at a temperature of sixty-five degrees, will develop the ordinary plate or cut film in approximately ten minutes. The operator will, of course, change this time to suit his own requirements, after a few experiments.

A standard M-Q developer for plates and cut films is this: *Stock Solution*:—Water (distilled), 40 ounces; Metol, 30 grains; Sodium Sulphite, 2 ounces; Hydrochinon, 140 grains; Sodium Carbonate, 2 ounces; Potassium Bromide, 100 grains.

For tray development, equal parts of stock solution and water should be used. For tank development, the dilution should be two ounces of stock solution with ten ounces of water. At sixty-five degrees, this will be found a slightly speedier developer than the pyro-soda formula previously given, eight to nine minutes being sufficient.

Amidol for Filmpacks. In handling stereoscopic films in pack form, longitudinal scratches on the back of the film sometimes are the bane of the operator's life. By the use of an Amidol-Sulphite developer, such scratches can largely be done away with. Lacking any carbonate, this developer does not have, upon gelatine, the softening effect of the usual developer containing carbonate. Hence scratches are minimized, as far as their bad after-effect is concerned. When films thus developed are dried, practically all trace of lengthwise scratches will be found to have disappeared. The developer formula is: Water, 1 ounce; Amidol, 2 grains; Sodium Sulphite, 12 grains.

The developer, as given, is for tray. For tank use, it should be diluted with four times the quantity of water, development taking from 14 to 20 minutes, according to temperature. For best results in both tray and tank, the developer should be used at a temperature somewhere between sixty and sixty-five degrees, the hypo following at approximately the same

temperature. The developer must be used when comparatively fresh—it will not give absolutely satisfactory results when kept much longer than twenty-four hours. It will be found that negatives developed in this developer are exceedingly pleasing and clear, and print as well as negatives developed with any other reducing agent.

A great aid to the development of pack films in the tray is to leave the black paper backing attached to the films when they are first placed in the developer. This paper keeps the films from sticking to each other during development and makes the paper and film combination much easier to handle than the film, alone. European films do not have the gelatine backing of the American film, as a rule, hence in the development of the average foreign film pack, retention of the black paper backing is not so essential.

Care Is Essential. Even more care should be observed, if possible, in developing negatives for stereoscopic work than for ordinary pictures. In the ordinary negative, "spotting" and retouching can be done successfully, so that it will not show in the finished print. No such luck in stereophotography. You look *through* the glass or film positive, rich in detail, in viewing a stereophotograph under modern conditions, and a "spotted" or retouched negative leaves a trail of "blobs" in the positive that nothing can eliminate and that, in the stereoscope, loom up to the positive and complete ruin of the picture.

Developing Autochrome Plates. In the development of autochromes, there is a technique which, when followed in detail, will always lead to successful and beautiful results. For this technique, the author is indebted to the late Robert J. Fitzsimons, the importer of autochrome plates into this country and an expert in handling them in all kinds of work.

After exposure, the autochrome plate should be put into the developing tray under safelight, while the tray is *dry*. The developer should then be poured over the plate with a sweep and development proceed according to schedule. At completion (using the time basis supplied with the plates and developer) the developer

should be poured off the plate and clear water poured into the tray to rinse the plate, then, after rinsing is finished and the water poured off (ten seconds of rinsing at this stage of the game is sufficient) the reversing solution should be poured over the plate, which is then carried into the daylight or under strong electric light. When reversal is completed, according to schedule, the reversing solution should be poured off, the plate rinsed again and the rinse water poured off, then the re-developer poured on and re-development completed. After this solution is poured off and the plate again rinsed, hypo is poured on to "set" the plate.

In all these procedures, it is to be noted that the plate has been kept in the same tray *and not handled*. This eliminates frilling of the very delicate emulsion at the plate-edge. Handling is absolutely fatal to autochromes until they are ready to be dried. One other point is to be regarded as absolutely essential: all solutions must be *fresh* and must not be used at a temperature lower than 60 degrees nor higher than 63 degrees, Fahrenheit. *This includes the rinse water*, as well as the developer, reversing-solution, re-developer and hypo.

Fresh Solutions. Many otherwise beautiful stereoscopic plates and films have been ruined by the use of old developer and old hypo. (The same is, of course, true of ordinary plates or films.) With fresh solutions, the reduction of silver is much better than with old developer and fresh hypo cuts out the non-reduced silver to much greater advantage than old hypo. At the same time, the use of fresh solutions largely avoids the appearance of stains on the negative and puts an end to frilling and blistering, in all but the most extreme weather conditions. It costs a little more to use fresh solutions and fresh hypo every time, but it pays financially, in the long run, in plates and films *not spoiled* to say nothing of time saved in speed of handling and—best of all—of pictures successfully developed that, if lost through the use of old solutions, could never be re-taken. Another very decided advantage in the use of fresh solutions is in the avoidance of any tendency toward reticulation, or emphasis of gelatine grain.

Wherever possible, *all* development should be carried on at a solution-temperature of not more than 65 degrees, Fahrenheit. In hot weather, it helps to cool the solutions with ice before use—and during use, if long-continued. Care should be taken to remove all ice, however, so that the moist gelatine is not scratched. All trays and tanks should be kept scrupulously clean.

Drying Negatives. Emphasis is to be laid upon the extreme care necessary in handling stereoscopic negatives, so there may be no dust spots, or scratches, on the finished product. Stereoscopic negatives dried in an atmosphere containing dust—be it ever so little—will make disappointing positives. Dust and detail do not go together—and *detail makes the stereophotograph.*

In a speed-emergency it will be found helpful to pour over the surface of the thoroughly-washed *plate* negative a little wood-alcohol, tipping the negative from side to side to let the alcohol work over its entire surface. Two minutes of this will result in the absorption of so much water, out of the gelatine into the alcohol, that, when the alcohol is drained off and the negative is set up to dry, the drying time is cut far more than in half. As you value your hope for future existence, however, do not try this with *film* negatives. Alcohol and film combine too readily. The result is sheer ruin.

It is worth more than the time and trouble involved to swab off every stereoscopic negative, at the end of its wash, with a small piece of absorbent cotton thoroughly soaked in water. Adhering specks of dirt or lint will be removed by the swab and the emulsion-surface left free to dry without mar.

Printing the Positive. The stereoscopic positive, or print, is not made from the negative by one direct printing, as is done in all single-lens pictures. Instead, the right hand half of the stereoscopic negative is printed onto the left hand half of the positive (plate, paper or film) and the left hand half of the negative is printed onto the right hand half of the positive. This, of course, takes two distinct printings, instead of the usual one printing. The process is generally referred to as transposing, and a specially-constructed printing-frame is a part of all stereoscopic outfits, to take care of trans-

position almost automatically. The cause for transposition has been so simply and thoroughly set forth in a previous issue of THE PHOTO-MINIATURE: No. 175 that a quotation of what is there written is entirely fitting. The explanation is given thus: "As everyone who has seen the picture-image on the ground glass of the camera knows, the camera inverts the image (turns it upside down) and at the same time reverses it as to right and left. In the case of the single-lens negative, we simply invert the print when we take it from the negative, and so view it correctly. In the stereo negative, the fact that there are two images side by side introduces a complication, and the mere inverting of the print does not straighten things out. Thus, when we print the stereo pair on a single piece of paper, from a single negative, i. e., where the two stereo negatives are on one plate as usually made, we get the picture seen by the right eye (in looking at the subject) on the left side in the print, and that seen by the left eye (in looking at the subject) on the right side of the print. If we put such a print in the stereoscope, we would fail to get the illusion of relief because we would be looking at the pictures from positions opposite to those from which they are taken. To get the illusion of relief or stereoscopic effect, we must have the "right" picture on the right side of the print and the "left" picture on the left side of the print. This is done very simply by . . . using a transposing printing-frame and thus transposing the prints during the printing."

Care must be taken, in printing the positive, to give the same exposure to one half of the print that was given to the other half. It is, to be sure, possible to print a straight positive from the negative (that is, one without transposition) then to cut the resultant two-picture positive in the center (from top to bottom) and transpose the halves. This is the preferred me hod in printing paper positives, but is much more difficult than transposition, in printing positives on film or glass.

The Ernemann and Ica lines of stereoscopic accessories contain transposing printing boxes which automatically handle the problem of transposition by the

introduction of a pair of lenses in the box, through which lenses the positive is printed by projection. This additional pair of lenses, of course, once more reverses, completely, each image, thus producing the same effect as the positive printed in the transposing printing-frame.

In making stereoscopic autochromes there is, of course, no printing of a positive. Unless a prism equipped transposing viewing box is used (and these are very expensive) it is absolutely necessary to cut the stereoscopic autochrome plate when finished, midway between the two halves, transpose the halves and mount them again—preferably under a glass cover. The whole is then bound, to preserve the transparency, ordinary passe-partout binding being about the best available for the work.

Positives On Paper. Years ago, when the large size stereoscope first adorned the parlor table, paper prints were made, as the only kind of positive available. They were, naturally, viewed by reflected light—that is, by light falling on and reflected from the prints themselves. The same kind of positive is generally used, to-day, with the American standard size stereoscopes and stereoscopic cameras. The paper positive is not so good, when put side by side with the more modern technique of printing positives on lantern slide glass plates or on commercial film. The production of the paper positive is identical with the production of any other paper print. The same exposure, development and fixation is gone through as with any single-lens-camera paper print. Then, when the positive is printed, it must be cut in halves and transposed, if printed in one direct printing (which is usual), or, if printed in a transposing printing-frame, is ready for viewing when mounted on cardboard. It is well to remember that glossy-surface paper is by all means *the* paper for stereoscopic positives. Detail is best handled on glossy surface paper—as witness to which is the almost universal requirement of newspapers, trade journals and halftone engravers that prints be submitted on glossy surface paper if satisfactory reproductions are to be made. Care should be taken, in printing paper

positives, to print fully and to give full development—this to bring out all possible detail. It is, perhaps, just as well for the beginning stereographer to make his first positives on paper (because of their comparatively low cost); but after you have once made good stereoscopic positives on glass or film, paper positives are relegated to the limbo of forgotten things.

Positives on Glass Plates. Beyond contravention, the best positives are printed on glass plates, just as lantern slides are printed, and using the same emulsion. In fact, lantern slide plates, in proper sizes, are ideal for stereo positives on glass. The lantern slide plate is coated with an emulsion so prepared that the image printed on it can stand great enlargement without the emulsion grain or the silver grain becoming apparent. That very quality makes the same emulsion ideal for stereoscopic positives, which must likewise be subjected to magnification in viewing. The lantern slide plate also gives additional contrast, when compared with the negative from which the slide was printed. This is generally desirable, likewise, in a stereoscopic positive, because the additional contrast tends to balance any flatness which was obtained in the negative by the full exposure which experience has shown to be the best for this kind of work.

Lantern slide plates need not be handled in ruby light. Orange, or even yellow light, will do. The technique of treatment varies with the brand of plate used, but, generally speaking, lantern slide plates require much longer exposure, shorter development, shorter fixation and longer washing than ordinary plates. The best possible advice is: use a standard make of plate and follow the maker's advice as to developer and any special treatment necessary.

In this country, most plate-makers produce lantern slide plates that, cut in proper sizes, are entirely satisfactory for stereoscopic positives. The better-known brands come in "ordinary" and "slow" emulsions, which vary in speed in about the ratio of four to one and which also vary considerably in contrast.

From abroad, the best plates for this purpose are the Wellington Lantern-slide, the Wellington S. C. P.

and the Ilford Lantern—best, that is, until you reach the Ilford Alpha, which is, in my opinion, the best plate in the world today for stereoscopic transparencies. This is true because the plate is readily handled in strong yellow light, develops and fixes rapidly, is not sensitive to handling, gives brown and red tones by direct development, handles all problems of contrast without difficulty and—last and most important—seems to be absolutely free from grain of any kind. I have enlarged positives printed on Ilford Alphas to a limit entirely beyond the realms of commonsense in an attempt to see just what the plates would stand—and I have, as yet, found absolutely no trace of grain. Directions for using Ilford Alphas are contained in every package and if those directions are carried out in detail, results are certain.

In making positives on glass, the same general procedure should be followed that has been outlined for making of negatives: clean trays, fresh solutions, temperature kept between 60 and 65 degrees, Fahrenheit, and care exercised to avoid scratches, dirt and lint. In the end, it will pay.

Positives on Film. Recent developments in the manufacture of commercial film have resulted in greatly decreasing the size of the emulsion grain, consequently this type of film is now being widely used for printing stereoscopic positives. The emulsion is unusually satisfactory to handle, being tough, quick to develop and to fix, and having much less than the usual susceptibility to scratches. Exposure of commercial film is readily controllable and the emulsion has much the same tendency to increase contrast as is shown by the lantern-slide emulsions. Incidentally, commercial film is the cheapest medium obtainable for printing stereoscopic positives in transparent form. As with glass, films should be handled with care and the same general treatment given as outlined in the second preceding paragraph.

Binding the Positive. The surest way to preserve one's pet positives—even those printed on glass—is by binding. A scratched positive, when viewed in the stereoscope, is one of the most unpleasant sights,

optically, known to photography. And scratches are absolutely certain to accumulate on positives if the surface of each is not protected by a cover glass. Old plates, from which the emulsion has been stripped, make the best possible covers. Cloth passe-partout binding is recommended for fastening the edges together. Incidentally, in binding, the operator can mask the edges of his positive to any given extent, either by varying the width of the binding or by cutting a black paper mask and slipping it between the positive and the cover-glass as a permanent part of the bound positive. Stereophotographs that are worth keeping at all are worth keeping properly. Granted there has been proper development, fixation, washing and drying (all of which, together, will eliminate staining or fading) binding will do more than any one thing to ensure the preservation of valued pictures. It is more than worth while.

If, however, one of the modern magazine stereoscopes—the Taxiphote, of Richard, or the Multiplast, of Ica—is to be used, positives cannot be bound because the bound positive is too thick to be handled by the magazine of such an instrument. In that case, the surface of the emulsion of the positive can be protected by a coat of negative varnish, carefully applied and properly dried.

Viewing the Positive. The completed stereoscopic positive is, to the unaided eye, merely two pictures, portraying the same objects, with a little more of one side of the view showing in one picture than in the other and with a little more of the other side of the view showing in the second picture than in the first; the two pictures separated, on the positive, by a band of clear glass, film or paper (according to the printing medium) from $^1/_{16}$ to $^5/_8$ inch wide. Put the positive, emulsion-side *toward* the lenses, into the stereoscope or viewing box, focus the lenses, and—presto! The two pictures are optically superposed, mental synchronization starts, and there is visualized a three-dimensional picture of the subject photographed, with proper perspective. The stereoscope is an absolute necessity to the completion of the process of stereophotography.

For correct or perfect viewing, the stereoscope (and by this term we include the viewing box) should be equipped with a pair of lenses of focal length identical with that of the lenses which were used in taking the picture to be viewed; and the viewing lenses should (theoretically) be anastigmatic. It would be impossible to construct such a stereoscope except as a companion for one certain camera (because of the focal length of lenses involved) and the proposition would then be commercially impractical. In practice, cheap, ordinary "spectacle lenses" of the proper focal-length to handle the size picture to be viewed, are used.

Types of Stereoscopes. The stereoscope of today is not the type which was first used for viewing. Invented by Sir Charles Wheatstone, in 1838, for viewing geometrical drawings of solid bodies, the original stereoscope was of mirror construction, instead of lens construction. It is not used, today, in ordinary stereophotography. The Wheatstone stereoscope was followed, some years later, by the first lens stereoscope—the invention of Sir David Brewster. The Brewster stereoscope was modified, in the mid-sixties, by Oliver Wendell Holmes, into the form which is in common use today. Various modifications of the Holmes stereoscope are to be had, the most desirable of which are the various folding models produced in Europe. For the small European, standard size stereophotographs, these folding models (of practically all-metal construction) are so small they can conveniently be carried in the coat pocket.

The viewing box of today is merely a special form of the ordinary stereoscope—a wooden box, having a pair of lenses (working on a focusing-rack) in one side and, in the opposite side, a ground glass panel. The positive transparency is inserted in a slot in one side of the box, just in front of the ground glass panel, and the lenses then focused as in using a pair of opera glasses. Richard manufactures a viewing box equipped with a pair of reversing prisms, working on the same principle as photo-engraving prisms. These prisms perform the left-to-right reversal and make unnecessary the usual transposition in printing. This type

of box is, of course, unusually desirable in handling stereo-autochromes, as it does away with cutting the autochrome, transposing the halves, and rebinding.

Many stereoscopes and viewing boxes are equipped with attachments to vary the lens separation, the better to accomodate different pairs of eyes. Such an attachment is, of course, highly desirable because it lessens eye strain in the case of an individual whose eyes are set nearer together or further apart than normal.

Just here it may be said with emphasis that glass or film-positives, viewed by transmitted light, are far superior, in general effect produced and in richness, to paper positives, which can be viewed, of course, only by reflected light. Paper positives are, on the other hand, much cheaper and in making them less care is necessary. Also, they are somewhat easier to keep than other positives and, of course, much lighter in weight. It is entirely a matter of choice with the maker, there being no other advantages to speak of. one way or the other. The autochrome is to be viewed, of course, only by transmitted light, if any real color value is to be obtained.

Magazine Stereoscopes. Mention has heretofore been made of the two standard magazine stereoscopes—the Taxiphote, made by Richard, and the Multiplast, of the Ica line. Both machines work on practically the same principle. The machine carries a number of metal trays, each tray containing twenty-five positives. When a tray is in position, a lever motion will carry into viewing position (a stereoscope, proper, is incorporated into the machine, at the top of the cabinet) one after another of the positives. The instruments are beautifully made—also quite expensive.

General Statement. It may be said, in general, that the stereophotograph can be artistic or pictorial only as the subject is artistic or pictorial at the time of photographing. As a record picture, however, the stereophotograph is without even a near rival. Its three-dimensional effect makes petty any two-dimensional attempt to compare, in the matter of exactness of a recorded scene. Consequently, *any subject of which*

a good record picture can be made is a good subject for a stereophotograph. The field is infinitely wider than either the record picture or pictorial field, using a single-lens camera.

Interiors can be beautifully recorded with the stereoscopic camera. Full value of distances can be shown to advantage, with furnishings occupying their proper places in the scheme of decoration or utility. The field of stereoscopic portraiture, with its visualized roundness and solidity of the sitter, is fertile: such a portrait is a thing never to be forgotten or laid aside, once properly made and viewed.

Out-of-doors stereoscopic opportunities and subjects are limitless. All landscapes furnish countless opportunities. Outdoor portraits, giving all the animation and vividness of the living model, are readily obtained. Genre subjects abound everywhere. Sooner or later, the stereoscopic camera will be used for wild-life photography and the pictures produced will be wonderfully interesting.

Commercial Stereophotography. Already, the value of stereophotography in commerce is beginning to be known. For the three-dimensional representation of various objects which cannot conveniently be carried from place to place by the salesman the modern stereophotograph is invaluable. Furniture, gowns, hats, jewelry—many lines of articles, in fact—are photographed stereoscopically and the salesman in his line starts out with his set of positive prints and his stereoscope, in addition to his catalogue descriptions and his price lists. Colors can be shown, where necessary, by the use of autochrome plates, thus adding to the finishing touch to the record picture, for sales purposes. Shape, color and size visualized before the prospect's eyes. What more can the salesman do, or the prospect require? From being, first, a theory, then a hobby, stereophotography is rapidly developing into a serious line of commercial work. It will become increasingly popular as the years pass. Its possibilities are limited only by the limit of development of general business.

Pointers Worth Remembering. These things are to be remembered—and *practiced*—in stereophotography,

if trouble is to be avoided: 1. *Use a Tripod.* Instantaneous exposures of longer than 1/25 second duration, with the camera held in the hands, are almost certain to be accompanied by motion of the hands or body, resulting in a slight general blurring of outlines which, in the stereoscope and under magnification, is ruinous. 2. *Use a Level.* Unless a stereoscopic camera is held practically level, irregularities of horizontal lines are introduced into the positive. It is possible to trim a single-lens picture to overcome such a defect but it is scarcely possible to trim a stereoscopic picture to overcome this defect. (It is, of course, *possible*, but the work required is so great the result is not worth the effort.) 3. *Use a Meter.* A direct-vision instrument, such as the Ica Diaphot, requires very little time to read. Such a meter as the Wynne, or Watkins—requiring the tinting of a piece of sensitive paper exposed to the light-source—takes more time to read than does the other type, but is more accurate. Milner's Light Meter is useful. A good exposure table, such as the Harvey, will serve admirably in place of a meter. A few plates, or films, correctly exposed in accordance with meter readings, but which would have been incorrectly exposed by "instinct", will soon pay for the meter. Even more important, the use of a meter makes certain that a picture will not be lost through incorrect exposure, with no chance for a retake. 4. *Use Clean Trays and Fresh Solutions.* What is the use of good judgment in selection of subject, proper handling of the camera, correct exposure and possession of high-class equipment, if dirty trays or tanks, or old solutions, in the darkroom, cause the loss of negatives through stain, fog, or emulsion marks? Such things can be avoided by scrupulous cleanliness and freshness of solutions. One picture lost in the darkroom is more than sufficient price to pay for carelessness. 5. *Accent the Foreground.* To give the right basis for visualized perspective, a strongly accented foreground object is absolutely essential. Carrying this thought a bit further it is well (in outdoor stereophotographs) to have the horizon line nearer the top of the picture than the bottom. 6. *Be Careful.* Care costs nothing and takes

but little time. It means length of life to instruments, less drain on pocketbooks, fewer strains on dispositions and more successful results. In other words, it pays — and pays big.

By following these pointers and working along the time-tried lines herein laid down, success in stereophotography is as certain as anything human can be. If you have read thus far, you have discovered that stereophotography is only a specialized form of making record pictures that are more lifelike and more real than pictures of any other kind. There is an attraction about the stereophotograph that never lessens, once it has been felt. If you have never tried it—change your ways; try it and see how "good" it is.

Using a Single-lens Camera. Not having any place in a discussion of practical stereography *per se*, but yet so closely allied to the subject that a discussion of its possibilities is entirely in place as an addendum, is the matter of obtaining stereoscopic results by the use of a single-lens camera. Such results can be obtained with very little trouble. BUT—the kind of subject available for such work can be set out briefly and completely in few words: a subject in which there is *absolutely no motion.*

The reason is this: to make a stereoscopic picture with a single-lens camera, it is necessary to make one exposure, move the camera, and make a second exposure, using the two negatives thus obtained as halves of a stereoscopic negative and printing a positive as usual in stereophotography. If, during the time taken to change position of the camera during the two exposures, there is any motion in the subject, there will be blurred outlines, loss of detail and—no stereophotograph. For subjects with life or movement then, there is no such thing as successful stereophotography without a stereoscopic camera which takes both negatives at the same time.

For still-life subjects, the situation is entirely changed. Stereophotographs of still-life subjects can be taken, using only a single-lens camera. The method is, in brief: Make one exposure. Move the camera directly to the right or left (as you face the subject) 2½ inches—

for the average subject at, say, ten feet or more—then make the second exposure. Develop the two negatives at the same time, in identical manner, and use the negatives as halves of a stereoscopic negative, printing the usual transposed positive. If the work has been correctly done, the result will be a perfect stereophotograph.

Some time ago a device was put on the market to be used as a tripod-head, into which the ordinary small camera was set, at one side of the device. Its construction was such that, after the first exposure was made, the camera was moved to the other side of the device and locked, while the second exposure was made, the device, itself, measuring the proper distance the camera should be moved between exposures. Unfortunately, the maker had overlooked the taboo of motion under such circumstances—and his device has never met with much popularity.

An Interesting Use. Commercially, however, the matter of producing stereophotographs with a single-lens camera brings out some exceedingly interesting points.

Thus it is frequently desirable to bring before one's prospects, for close observation, a three-dimensional reproduction of some object that can not be successfully photographed from a reasonably short distance. For instance: it is at times desirable to produce a stereoscopic reproduction of an automobile in such a way that the image is apparently an absolutely detailed model of the large machine, but set only two feet from the eyes of the viewer—so that all detail can be seen. It is manifestly impossible to photograph an automobile from a distance of two feet and get the entire machine in the picture. It is likewise manifestly impossible to produce an absolutely perfect machine in such miniature that it could be photographed from a distance of two feet. Stereoscopic photography solves the problem—with the aid of a one-lens camera, if you please, or with the stereoscopic camera used "half at a time", as it were.

With one lens of a stereoscopic camera capped, so that only one-half of a complete stereoscopic negative

can be made (or with a single-lens camera) an exposure is made through the uncapped lens, directly toward the object being photographed. The entire camera is then moved to the right or left (according as the first picture has been made to correspond to a left-eye or right-eye view of the subject), and another picture taken (using the second lens of the stereoscopic camera and capping the lens used in the previous exposure) with the lens pointing in a line *absolutely parallel to the line of taking of the first picture.* The two pictures thus obtained are used as the halves of a stereoscopic negative.

By the use of the following table, showing *how far to move the camera*, under different conditions shown in the table headings, *between exposures*, the two negatives thus obtained will, when printed and transposed, be found to produce a positive that, when viewed, will give the desired stereoscopic effect.

In the table, the first column represents, *in feet*, the distance from the camera to the object being photographed. The top line of the table represents, *in feet*, the distance from the viewer (the visual distance) to which it is desired to bring the object *visually*. The intersection of each column and horizontal line represents, *in inches*, the correct distance to move the camera, between exposures, for production of the particular stereoscopic effect desired.

	1	1½	2	2½	3
100	250	166.6	125	100	83.3
75	187.5	125	93.7	75	62.5
50	125	83.3	62.5	50	41.6
25	62.5	41.6	31.7	25	20.8
10	25	16.6	12.5	10	8.3

As an example: to photograph an automobile, at a distance of seventy-five feet, so that, in the stereoscopic positive, the machine shall appear to be at a distance of two feet (appearing, of course, in miniature), we find, in the second line of the table above, under the selected viewing-distance (top-line) 2, the figures 93.7. This means that after the first picture of the automobile has been taken, at the selected distance of seventy-five feet from the machine, the camera must be moved directly to one side or the other 93.7 *inches* before the second

picture is taken, in order to get a pair of negatives that will produce the desired stereoscopic effect.

The Formula. The entire proposition, for any combination of actual distance and visual distance, is covered by the following formula, in which S is the separation between lens positions in taking the two pictures to be used as a stereoscopic pair (in other words, the distance the camera must be moved between the first and second exposures), D is the visual distance to which the object photographed is apparently to be brought, and D′ is the actual distance of the object photographed: $S = \frac{2\frac{1}{2}\, D'}{D}$. It need not be explained how the formula is developed, further than to point out that it is a purely trigonometrical problem of the most simple kind. The point is that the formula expresses a general law, and may be depended upon to cover every case.

A very simple proof of the accuracy of the formula is given by expressing, in terms of the formula, the problem of any *ordinary* landscape stereophotograph: what lens-separation is correct in order to reproduce any object in the landscape at its actual distance (as far as viewing is concerned)? In such a case, D and D′ would, of course, be identical, (since we are to view the object at its actual distance) and the formula would become $S = 2\frac{1}{2}$, which we know to be correct in the ordinary stereoscopic case, because $2\frac{1}{2}$ inches is the normal eye-pair separation in the human head and is the ideal distance for lens-separation in a stereoscopic camera for general landscape-work.

Dale John Crittenberger

Photographs in Colors

The word photograph, used alone and without qualification, has always meant and still means a positive, photographic print on paper, made from a negative image on glass, film or other transparent support. Every other sort of photographic positive is, or should be, distinguished by a descriptive name, e. g., photographs on wood, photographic transparencies (on glass or film), ferrotypes (on metal), ceramic photographs (enamels), and so on. This explains why the world has always refused to recognize as photographs in colors even such beautiful color renderings as those given by the Kromskop, or the Autochrome, Agfa, Paget and other color transparencies so generally used today where a color record is needed for projection or reproduction work. They are not color prints on paper, and so not photographs in colors according to the generally accepted meaning of the word photograph.

This much by way of introduction to a brief account of Raylo Color Photography, a new process which gives photographs in colors, i. e., color prints on paper from a photographic negative. This process has been developed by Mr. Hiram C. J. Deeks, of the American Raylo Corporation, New York, and embodies the results of some ten years research and experiment. The frontispiece of this issue of The Photo-Miniature is a process color reproduction of a portrait made by the method. It gives a fairly close approximation to the coloring of the original print, the latter, however, being softer and more delicate in coloring and effects.

As most readers of The Photo-Miniature know, many processes for producing direct color prints by photographic methods have been introduced during the past few years. Some of them, e. g., the Hicro, Pinatype, Utocolor, Raydex and the tri-color carbon and allied methods have yielded color prints leaving little to be desired on the score of quality and interest. But they all failed to come into popular use, either as

being impracticable or tedious in manipulation and uncertain in result. The direct color print method of Henrietta Hudson, patented a few months ago, is not yet commercially available.

The principles underlying these methods may be generally stated as follows. The first and most important requisite is a set of three color-separation negatives, recording respectively the redness, greenness and blueness of the subject photographed. From these negatives positive prints are made, either on pigmented tissues or films which are later dyed, so that a bluish-green positive is obtained from the redness negative, a pink-magenta positive from the greenness negative, and a yellow positive from the blueness negative. These color films are then superimposed in exact register on the white paper support, the combined image giving a photograph of the subject in its natural colors. A clearly detailed account of the manipulation followed in this class of methods may be found in THE PHOTO-MINIATURE: No. 128.

In practice the obtaining of the three color-separation negatives, so that they accurately record the color luminosities and color contrasts of the subject, offers many difficulties, correct color representation here depending upon the precise adjustment of the relation between the sensitive emulsion used, the three color filters and the timing of the exposures. It is essential that these three factors shall be so coordinated that the component colors of the subject are recorded in the separation set in the same scale, so that when recombined in the final color print a true reproduction of the colors of the subject will appear. There is also the problem of speeding up the making of the negatives so that the total period of the three successive exposures shall be sufficiently brief to permit the photographing of different classes of subjects, i. e., landscapes with clouds, children, flowers, excepting, of course, subjects with rapid movement.

Similarly the making of the color positives, whether direct pigment prints or dyed films, transferring them from their temporary supports and superimposing them in exact register so as to recombine the picture

image in its proper coloring, involves much patience and skill and is, apart from the Raylo method, beyond the capacity of the average worker. There is also the problem of obtaining color tissues or dyes of such transparency and brilliance as to preclude any heaviness or loss of brightness in the print.

In the Raylo Color Process or system these difficulties have been eliminated, and the method so simplified and systematized as to be, in large part, automatic in manipulation and certain in result. I use the word system advisedly, because the years of research and experiment devoted to the process by Mr. Deeks have resulted in a specially designed camera, and developing and printing methods, so cleverly co-ordinated in a series of interlocked steps or operations, as to enable anyone of average intelligence to produce photographs in colors almost as easily as one makes black and white photographs of the ordinary kind.

The Raylo camera resembles the familiar reflex camera type, measures about 6 x 6 x 10 inches, and is operated as one uses an ordinary camera except that it is pivoted in a special holder and used on a tripod. It is equipped with a Goerz Hypar F: 3.5, the diaphragms being controlled from the top of the camera, where also we find the focusing scale and dial for setting the shutter. It has a deep set finder giving a brilliant image even in bright sunlight. Exposure is effected by cable release, a single pressure of the release giving the triple exposure needed for the three color-separation negatives. The exposures are automatic and range from ¼ second to exceeding 30 seconds for the total exposure of the three color records, giving three negatives, each 1 x 1½ inches, on a single plate 1¾ x 3¼ inches.

The special panchromatic plates used in the Raylo camera are carried in a magazine containing six plates, which fits into the top of the camera. By turning a key, after focusing and adjusting the diaphragm, a plate drops into place in the camera ready for exposure. The handling of the camera, focusing, changing the plate after exposure, etc., are fully explained, with numerous diagrams, in the booklet published by the

makers of the camera and so need not be further detailed here. For the development of the plates, without a darkroom or individual handling, a daylight developing box is provided, in which the six plates are developed and fixed after the familiar method of tank development.

From the triple negative so obtained any number of color prints may be made. The method of printing is by projection, the three images being projected on a Raylo color sheet, which is a sheet of celluloid carrying three patches of light-sensitive, pigmented gelatine, each of the size of the finished print (either $2\frac{1}{4} \times 3\frac{1}{4}$ or 5×7 inches). The exposed prints are developed in warm water and dried, the color sheet now bearing three prints of the subject in red, yellow and blue respectively. By means of an ingenious "combining" board the three color prints are successively transferred and superimposed in exact register on a sheet of paper, which gives the finished print, reproducing the subject in its natural coloring.

The making of Raylo prints, while simple and rapid in practice, calls for special equipment and materials, i. e. the color sheets, combining board and projection apparatus, which most users of the process may not care to bother with. It has therefor been arranged so that Raylo plates, developed or undeveloped, may be left with the dealer for finishing and printing, just as the amateur leaves his films with the dealer for the same purpose, but in this case the prints will be made by the American Raylo Corporation. Or, if preferred, the magazine containing the exposed or developed plates may be sent direct to the company's laboratories for this finishing and printing.

The Raylo color process is, as has been said, simple, largely automatic and entirely practical. It brings the production of photographs in colors within the reach of all who have an intelligent grasp of everyday photography, and obviously holds great possibilities for pleasure and profit. Nevertheless, as Mr. Deeks points out: "It is a tool only, and will give satisfactory and successful color results just in proportion to the amount of intelligence put into its use." By this warn-

ing, I think, Mr. Deeks intends to convey the suggestion that picture making in colors (by any method) calls for careful consideration in the choice of the point of view, arrangement or composition and lighting of the subject from the standpoint of color. In other words, now that we have a practical method of color photography, photographers will have to learn to think of and handle their subjects in terms of color, just as the painter does. Looked at from this angle photography in colors is something very different from the black and white photography we know. But the ability to add the charm of color to one's camera work will abundantly repay the obligation to study and understand the difference between the methods.

News and Comment

The Cine-Kodak. Surely we are living in wonderful times. On other pages of this issue the happy reader will find news of a method which means photographs in color for everybody—the Raylo process. And here we announce the coming of the Cine-Kodak, which means motion pictures for everybody. I have seen the Cine-Kodak displayed in several dealers' windows, and Dr. C. E. Kenneth Mees, who, by the way, sailed, with his family, a few weeks ago, for a visit to London, showed me some excellent work done with this latest addition to the far flung Kodak line. Dr. Mees is convinced that the Cine-Kodak, because of its outstanding efficiency and extreme simplicity in use, is going to make a stir in the world. Meanwhile I hear that the Kodak people cannot hope to supply all the Cine-Kodaks ordered before next Spring. You can get the descriptive booklet and possibly see the Cine-Kodak, as the advertisements say "at your dealers."

"The Complete Photographer," by R. Child Bayley, has reached its seventh edition, just published here, at $5. I hope to make room for a more extended notice of the book in a forthcoming issue, having always regarded it as the most interesting and useful book in English about photography. Meanwhile, congratulations to Mr. Bayley on his appointment as a director of Iliffe and Sons, Ltd. of London and Coventry.

"Agfa." Mr. George Barrows who, as President of the Sagamore Chemical Co., has for some years past handled the "Agfa" line of developers, chemicals, plates and films in this country, advises me that these famous specialties will hereafter be imported and distributed in the United States by Agfa Products, Inc. which succeeds to the Sagamore concern. The line is being largely augmented by the addition of Agfa color plates, a new filmpack, X-ray plates and films, etc. Mr. Barrows will continue to head the business.

In the California Redwoods

Dr. George C. Bull

A Red Warbler visiting its nest

W. Farren

Half Dome: Yosemite Valley
Evelyn Blackman

The Llugwy, at Capel Curig, North Wales
J. T. Ashby

Springtime

C. F. Baker

Music

Max D. Brunner

A Sunken Garden

F. Dundas Todd

The Boys

Thomas D. Tennant

The Photo-Miniature

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Out-of-Doors With a Hand Camera

Life is a great adventure — indoors and out. Accidents apart, the adventure begins and ends indoors, for here few of us have any choice or say as to when or where. But between these poles—beginning and end—most of us prefer to be and live out of doors, wayfaring or seafaring under the open sky. There is, in truth, an irresistible charm about the world of out of doors which, despite all our make believe and invention, never seems to get indoors. It is a world in which one is forever making new discoveries of interest and beauty. There is no knowing what lies beyond the further hill or around the corner. The heart leaps, the step quickens, and the whole man awakens at the mere impact of the open air. The delight of the winding hill road and purling brook while the day is young, the sheer joy of falling water and the zest of mountain climbing; the continual miracle of light and shade in quiet valleys and the freedom of windswept spaces; the varicolored panorama of sunlit streets and the jewel-tipped skyline of the city against the glow of sunset; the play of sun and cloud on the sea, and the

snowclad landscape with a beauty which is not like any other beauty; all these are out of doors. And all outdoors invites the camera, the hand camera, of course, since we are of today and not of yesterday. By which photography is seen to be an enrichment of life and a hand camera the boon companion in the great adventure. It is from this viewpoint that we are going to consider hand camera work in these pages; as a means of adding to the joy of life out of doors.

Of the hundreds of different hand cameras in the world's markets little needs to be said. Doubtless the reader has chosen for himself before this meets his eye, and we are here concerned with the use rather than with the choice of the hand camera. It matters little today, what sort of hand camera you have, but much how you use it. As to which, since here ignorance is far from bliss, something must first be said about your camera, and thereafter about your handling of its capacities.

The Camera itself is simply a lightproof box or chamber, with a lens at one end (the front), and a device for holding the sensitive film or plate at the other end (the back). Add to these a mechanical device, either as part of the lens fitting or immediately in front of the film or plate, which will uncover and again cover the lens and thus control the exposure; another device which tells us when the picture-image is properly placed within the limits of the sensitive film in the camera; a third device which will adjust the separation of lens and sensitive film so that the picture-image will be agreeably defined or focused on the film, and you have all the essentials of a hand camera.

Evolution. Because it is designed for use in the hand and to be carried without inconvenience, the evolution of the hand camera has been in the direction of smallness of bulk, compact-

ness of construction and equipment, lightness of weight and the utmost optical efficiency, i.e., lens and shutter speeds. Thus from the Shew folding hand camera of 1886, for pictures 3¼ x 4¼ in., which could conveniently be packed in a traveling bag, we come to the Kawee of 1923, for 3¼ x 4¼ pictures, which folds to a thinness of less than 1½ inches, and the Vest Pocket Kodak, Ansco, Icarette, Piccolette, Cocarette, Tenax, Makina, Ernemann, Ensignette and Carbine, all easily carried in the pocket or lady's handbag. In this striving for extreme compactness, the vital fact that the focal length of the lens controls the scale of the picture-image has been disregarded, so that hand camera pictures are generally characterized by their small scale images and the inclusion of a generously wide field of view. The reaction against these characteristics has led to modifications in optical equipment, in the form of fixed-focus telephoto and supplementary lenses, such as the Dallon and Teleros lenses, the Distar and "portrait" attachments, giving a larger image and agreeably narrower field of view. Other recent improvements in hand camera construction are the fitting of miniature models with extremely rapid lenses (F:2.9 to F:4.5) and focal plane shutters, such as the Dallmeyer Speed and Ernemann Focal Plane, the Goerz Ango and Deckrullo-Nettel cameras. For pictorial work with the hand camera we now have the soft-focus supplementary lens, such as the Wolfe "Artistic."

The Outstanding Advance in hand camera construction, however, is seen in the efficiency and simplicity combined in the inexpensive hand camera of today. The refinements and improvements found in the most expensive models obtainable undoubtedly add to the usefulness and efficiency of the hand camera, and are worth their cost; but the man with a little hand camera

costing $10 or less, if he knows his camera and how to use it, can fill all his heart's desire with it in picture making out of doors, just as successfully as the proud owner of "the last word".

Know Your Camera. The first step in all hand camera photography is to know your camera. More than ninety per cent of the beginner's failures in outdoor work result directly from his or her inexcusable ignorance in this detail. You can cut down this unnecessary waste, expense and disappointment by knowing the practical range of capacity of your camera before you begin to use it. This known, study how to use its capacities to the best advantage by familiarizing yourself with its parts and movements, so that the purely mechanical handling of the camera can be done without fussing and distraction, leaving your attention free for the subject and light conditions at the time of photographing. Learn, especially, the limitations of your camera; what it cannot do for lack of this or that capacity, i.e., what subjects or conditions make success impossible with the particular camera you use.

This may seem tedious and you may think I am stressing petty details; but a long experience has told me that most of the failures and disappointments of the amateur's early work arise simply from his or her neglect of this preparedness. Hand camera photography is not as simple or as automatic as it is said to be—until you know your camera.

This knowledge of the hand camera can be had very easily by a careful study of the camera and its operation, with the help of the instruction book furnished with the camera. Take this page by page, with the camera in hand, and drill yourself in its handling until you are thoroughly familiar with all the steps leading to exposure. After this preliminary study, expose a roll of

film or a few plates to test your knowledge of the camera and its operation. Finally read everything you can find about lenses, finders, shutters and camera parts, and so get a clear grasp of the limitations of the particular camera you possess and will work with.

Inexpensive Cameras. If you have a little. inexpensive camera, simple in design and equipment, its operation will generally be found to be almost automatic and can be learnt with very little effort. Here the limitations are of prime importance. The lens aperture will be so small that you can use the camera (in the hand) only under favorable light conditions, rarely on dull days or early or late in the day or season of the year, or for large dark objects near at hand. Obviously these limitations seriously restrict your use of the camera as to time and place of photographing. But if you know them beforehand, you will not waste time and film on things obviously beyond the capacity of the camera, such as woodland scenes in the late afternoon, motor boats on dull days, and little Mary in a dark dress, fondling a black cat with a white nose. With a tripod or support of some kind, of course, all still subjects are possible, from the dark ravine to the old bridge at midnight. When you know the limitations of your little camera, and how to use it intelligently, you will find that it has a surprising range of possibilities, and that, when conditions are favorable as to subject and light, it will give you just as good pictures as can be made with the most expensive and complex cameras. The Yosemite scene by Miss Blackman, among the illustrations of this issue, was made with a Box Brownie and proves everything said in this paragraph. Miss Blackman chose her subject and time of photographing well within the capacities of her camera, and so secured as good a rendering of the scene as the

most expensive hand camera in the market could have given her. The original print, by the way, is very much better than the engravers' reproduction, although they made two attempts to translate it.

High-Grade Cameras. If, on the other hand, your camera is a high-grade instrument, with all the movements and the last word in optical equipment, you will still have failure on failure until you know your camera and are familiar with its handling. In fact, the "finer" the hand camera, the more certain it is that you will have more trouble with it than with the inexpensive model until you know its larger capacities and how to handle and control them. But with this knowledge the high-priced camera is well worth its cost, because of its freedom from limitations, its wide capacity and efficiency, and the ability it gives you to photograph what you will, regardless of subject, light or conditions.

The Lens. The all-important feature of the hand camera, and the principal difference between one camera and another, lies in the optical equipment, which comprises the lens and the exposure shutter. The possibility of making a photograph of any subject whatever depends wholly on the ability of the lens attached to the camera to admit to the sensitive film, during the period of exposure, a sufficient volume of the light reflected from the subject, to impress a developable image of the subject on the film before there is any movement, either of the camera or in the subject. The light-passing capacity of the lens, therefore, is the measure of the picture-making ability of the camera. The significance of this lies in the fact that, necessarily, all hand camera exposures must be very short. They are, in fact, always some fraction of a second. Using the hand camera on a tripod or other support, we can, of course, give as long an exposure as we desire;

but working with the camera in the hand, it is hardly possible to hold the camera perfectly still, without tremor or movement, for more than 1/10th of a second. It is wiser, in practice, not to depend on one's ability to hold the camera steady for more than 1/25th of a second, until by drill and practice we are sure of our ability to do better. On the other hand, many outdoor subjects include movement, in which case the exposure must be within the time in which the image will move 1/100th or even 1/200th of an inch on the sensitive film. This period depends on the rate at which the subject is moving in its field, but will always be less than 1/10 of a second, and may be from 1/100th to 1/1000th of a second.

Know Your Lens. Grasping this vital capacity of the lens fitted to your hand camera, what else should you know about it? First, its focal length. This term expresses the distance between the center of the lens and the sensitive film when a distant object is sharply focused on the film. It is always given in the specifications of the camera in the maker's catalogue or engraved on the lens mount. It is important because it determines the scale or size in which an object at any given distance from the camera will be reproduced in the picture. The greater the focal length of the lens, the larger will be the scale of the image obtained. Of course the bellows or camera body extension capacity controls the focal length of the lens which can be used with that camera. Since the scale or size of the image is important, it is well to choose a camera having bellows or body extension capacity at least twice as long as the focal length of your lens, so that you can use either the whole or half of the lens, and so vary the scale of image in your pictures where this is desirable. This means that a "double extension" camera is more useful or

more desirable than the usual "single extension" model. If your hand camera is of the latter variety, you can vary the scale of your picture images by the use of a "portrait attachment" or the more modern "fixed-focus" telephoto lens, which gives an image of about double the normal size with the normal (single) camera extension.

The focal length of the lens in relation to the base line measure of the film or plate used determines the angle of view (amount of the subject) included in the picture. As the focal length of the lens increases the angle of view is narrowed and the size of the image increases, with more pleasing drawing or perspective effects.

Lens Speed or Rapidity. This depends on the light-passing capacity of the lens. It is measured by the relation between the size of the largest aperture or "stop" and the focal length of the lens. The larger the aperture, the greater the volume of light passed to the sensitive film in a given period, and the more "rapid" the lens. Lenses which will give a sharply defined and evenly illuminated picture image over the whole of the film or plate in use, at a large aperture or "stop," are costly in manufacture, so that speed or light-passing capacity (meaning the ability to photograph all classes of subjects under difficult light conditions or including rapid movement) means expense. Obviously such lenses add largely to the usefulness and efficiency or range of efficiency of the camera as an instrument used in the hand, and so justify their cost.

"Stops" or lens apertures, sometimes spoken of as diaphragms, are thin metal or hard rubber plates, usually inside the lens fitting, which vary in size of aperture and regulate the amount of light passing through the lens to the sensitive film in any given period of time. They are usually arranged in the form of an iris, opening from and to the center of the lens, according to a scale of numbers marked on the lens mount.

F: Values. There are several different systems of numbering or marking lens apertures, but that most commonly used is the "focal value" or F: (f/) system, which expresses the relation between the diameter of the aperture and the focal length of the lens. For example: if we have a lens of four inches focal length and the diameter of the largest aperture is one inch, that aperture is known as f/4, being one-fourth of the focal length of the lens, and the lens is described as having a speed or rapidity of f/4. Reducing the aperture to half an inch, we get f/8, equalling one-eighth the focal length, and so on down to the smallest aperture f/45, which is 1/45th of the focal length of the lens. A disadvantage of this system is that it provides no fixed ratio between one aperture and another, which would help us in estimating the exposures required with different apertures. On lenses marked by this system we usually find the series: f/2.9, f/3, f/4.5, f/5.6, f/6.3, f/7.7, f/8, f/11.3, f/16, f/22, f/32 and f/45. On some Continental lenses we may find the series: f/3.5, f/4.7, f/9, f/12, f/18, f/23, f/25, f/50.

U. S. Nos. In another system, known as the U. S. or Uniform System, the lens apertures are arranged and numbered, from the largest to the smallest, so that each succeeding aperture is about half the area of the aperture preceding it, and so requires double the exposure which the preceding (larger) aperture would require. This series is a help in calculating exposures as there is a definite and readily remembered relation between the exposure required with any one aperture and that required by any other. In this system the apertures are numbered 1, 2, 4, 8, 16, 32, 64, 128, and the exposures required with the different apertures follow in the same ratio. Thus we can put the two systems in order as follows, indicating the exposure ratio under each f/ or U. S. number:

f/ value	4	4.5	5.6	6.3	7.7	8	9
U. S. No.	1	1.2	2	2.5	3.7	4	5
Expos. ratio	1	1.2	2	2.5	3.7	4	5
f/ value	11.3	12	16	18	22	23	32	45
U. S. No.	8	9.2	16	22	32	33	64	128
Expos. ratio	8	9.2	16	22	32	33	64	128

Exposure Shutters fitted to hand cameras are of three varieties: (1) The most widely used type being the "between lens" shutter, operating between the lens elements, sometimes in the form of an iris diaphragm with speeds marked from 1 to 1/100th second, or in the form of a star-shaped device, with greater efficiency and speeds marked from 1 to 1/300th second. (2) A metal plate with two or more apertures, rarely larger than f/16, which is thrown across the lens by a spring or lever, thus giving the exposure. These are fitted to the less expensive box hand cameras. (3) Focal plane shutters, so called because they operate immediately in front of the sensitive film (near the focal plane), and consisting of a spring actuated opaque curtain, having slits or openings across its full width. This form of shutter ranks first in practical efficiency, with speeds from 1/10th to 1/1000th of a second.

Three Essential Operations. In making a picture with a hand camera, whether it be a mere "snapshot," a record, or a work of art, there are only three essential operations or things to be done. These are "finding," or properly locating the subject on the film or plate; "focusing" the picture image to insure its proper definition or sharpness in the negative; and giving the correct exposure required to reproduce in the print the form and light and shade effects of the subject.

The Key to Success. If you will master these three essential operations, you can be sure of success in your hand camera work. Until you have mastered them, there will always be a varying percentage of failure and waste. And your mastery of them depends wholly upon your knowl-

edge of your camera and familiarity in its use—regardless of its name, style or price. This mastery you can get by a careful and repeated study of your camera with the little instruction book which came with it, and careful and repeated drill or practice in its actual use. Let us consider, very briefly, these three essential operations which are the key to success.

Finding the Picture. This simply means making sure that the scene or object to be photographed is properly placed or arranged within the limits of the plate or film in use. You "find" by means of the "'finder," which is an essential feature of all hand cameras not fitted with the regular ground-glass focusing screen found at the back of ordinary view or commercial cameras.

Finders are of three or four varieties. Each kind is sufficient for its purpose. The vital thing is to be skilled in the use of the finder on your camera and to get the utmost efficiency out of it. The commonest form of finder is the tiny brilliant finder, usually located on or near the upright supporting the lens and shutter. It gives a small but bright image of the object at which it is pointed, and is supposed to be adjusted, as to its position, as to show just how much or what part of the subject will be included within the limits of the plate or film used. This showing will be seen to vary according to the angle at which one views the picture-image on the finder screen, the only correct way of finding with this type of finder being to look down at the finder screen from a point directly above the center of the finder screen. The smallness of the image is the principal drawback to this finder, but many workers use such finders with complete success, even in pictorial composition. The best finder for such work, as well as for moving objects is, of course, the full-size mirror finder (really a focusing screen) fitted to cameras of the reflex or

Graflex type. These give a full-size image of the subject, right side up and completely under control, up to the instant of exposure.

Then there is the direct-vision finder, a condensing lens of rectangular shape, usually attached to the top of the camera and looked at (not into) through a small folding "sight," which erects itself at a little distance from the finder screen. This type offers the advantage of a fairly large picture-image of great clearness and brilliancy, and obviously necessitates the use of the camera at eye level.

My Preference among finders is the full-size wire frame, direct-vision finder, fixed above the lens and folding down over it when not in use, with an eyepiece or "sight" placed over the plate or film in line with the center of the finder. In my experience this form of finder has proved as effective as the mirror finder, giving a full-size view of the subject and enabling one to follow moving objects. It necessitates the use of the camera at eye level, but this has many advantages, apart from the natural view of the subject so obtained. Thus, if the camera is very small and somewhat awkward to hold steadily in the hand while exposing, the use of this finder obliges one to hold the camera against the nose and eyebrow, thus steadying the instrument during exposure. The leveling of the camera is easier and surer with this finder than with the tiny box finder, and the height of the viewpoint is very simply varied by kneeling, leaning or sitting when photographing small objects or subjects calling for a low position.

The Vital Point in the use of any finder is to make sure that the object of chief interest is well within the limits of the finder, especially where large figures or objects near the camera are being photographed. Learning how to "find" means knowing the particular finder on your camera and skill comes only with experience. In

the use of small box finders, it is especially necessary to appreciate the influence of the slightest movement in changing the arrangement of the subject on the plate or film, and to learn to hold the camera without movement after "finding" until the exposure is made. You must not forget that finding the picture does not include focusing the image (except in the case of focusing finders, e.g., the mirror finder of the reflex camera), so that having learned how to find, you must next turn your attention to the focusing of the picture-image on the plate or film.

Focusing the Picture. This simply means getting the subject in focus or sharply defined as to its outlines and details on the film or plate in the camera. Since the photograph will not please or satisfy unless it presents the form and details of the subject with reasonably sharp definition, as seen by the eye, it is obvious that "focusing the picture," i.e., securing the desired degree of sharpness of definition, is fundamental.

The method of focusing varies in different kinds of hand cameras. In reflecting-mirror cameras, and in all cameras equipped for use with plates and possessing a ground-glass focusing screen, the picture-image is focused by adjusting the separation of the lens and focusing screen until the image of the subject is seen to be sharply defined on the screen. This adjustment may be done by simply sliding the front of the camera backward and forward to and from the screen (in grooves on the base of the camera), and fixing or clamping the front at the point where the "focus" is obtained. Usually it is done by means of a rack and pinion screw movement operated by a milled head attached to the lens front of the camera and projecting at the side. This is the perfect way of focusing not only because the picture-image is thus under actual observation, but also because it gives complete control over the definition of the image.

In "Fixed Focus" Hand Cameras, or in "focusing cameras" fitted with an "automatic focus lock," the lens is fixed at such a distance from the film or plate that all objects beyond a certain number of feet away from the camera will be in focus, i.e., equally well defined or agreeably sharp in the negative without any adjustment on the part of the user of the camera. Here the operation of focusing is eliminated. Loaded with film or plate, the "fixed focus" camera is always ready for exposure without further adjustment than the correct "sighting" of the subject on the finder.

Focusing by Scale. The majority of hand cameras have no focusing screen, being intended for use in the hands, which hardly permits the use of such a screen except where it is set in the top of the camera, e.g., in the reflex type. For this reason the focusing of the picture-image is generally done by means of a focusing scale. This is a small tablet of metal or celluloid fixed to the base of the camera at one side of the lens front. It is marked by cross-lines numbered with figures indicating feet, metres, or yards. As the lens front of the camera is extended, a small pointer attached to the lens front moves over the cross-lines of the scale, and the lens front may be fixed or clamped at any point indicated on the scale. This fixes the separation of the lens and film and is said to "set the focus." The focusing scale is, of course, marked and adjusted for use with the particular camera and lens to which it is attached. Thus, when the pointer is set to the cross-line 10 on the scale, this indicates that objects lying 10 feet away from the camera are in focus, and so on. At one end of the focusing scale the letters INF (an abbreviation of the work "Infinity") are marked. This, in practice, simply means that when the pointer is set at this mark, all objects beyond a certain distance away from the camera (the "hyperfocal distance") will be in focus in the negative.

Judging Distances. Success in focusing by scale depends, very largely, upon your ability to correctly estimate the distance away from the camera (in feet or yards) of the part of the scene or object to be photographed. This ability must be acquired either by drill and experience, or by the use of a distance-finding device, such as the Kodak Range Finder (which, as yet, is available only with some Kodaks), or the Heyde Foto Distance Meter, which may be used with any camera.

The following method can be recommended for training the eye, and when once the lesson has been thoroughly learned, it is difficult to go wrong. When out walking, choose a number of feet, say 25, and as each street-corner, pillar-box, lamp-post, etc., is approached, a guess is made as to when you have arrived at a distance of 25 feet from the object. It is then measured with full strides—each stride being approximately three feet. This is repeated with the next convenient object, and on all possible occasions for one or two days, until the eye has got a good grip of the 25 feet distance with all sorts of objects and under different conditions. Follow this with another distance, say 15 feet, and continue the exercise until this is well drilled into the eye. Several distances, e.g., 15, 25, 50, 75, 100 feet, can be thoroughly learned in this manner with practically no trouble, but only a little thought every time you go for a walk in town or country. The next course is to stop at all sorts of irregular distances during our walk, e.g., 18, 30, 40, 60 feet, guess the distances at once, and then verify by long strides. Then the new power thus obtained can be applied to the hand camera, and, provided the scale is correctly marked, very few spoilt plates or films will result through being out of focus.

The best, i.e., most useful of all distances to get well fixed in one's eye, is 25 feet, as this is in many cases the nearest distance one can have foreground

figures (on a quarter-plate with 5-inch lens) without the near figures looking out of proportion in comparison with others at, say 50 feet distance.

Simplifying Focusing. The use of a range finder such as that fitted to some Kodaks simplifies focusing since the adjustment of the finder image involves the automatic focusing of the picture. Similarly, one may eliminate the focusing, as a necessary preliminary before each exposure when working with a scale-focusing camera, by setting the scale pointer over the 25-feet distance mark adjusting the lens aperture to f/11 or f/16, and using the camera as a fixed-focus camera as long as subjects and conditions permit. If the day's work includes chiefly distant views or open landscapes without prominent near objects, the scale pointer may be set over the 100-feet distance mark on the scale. For figures, not too near, set the scale pointer at the 15-feet mark. Under average conditions an exposure of 1/25th second will give good negatives with the camera so adjusted.

Selective Focusing. It is commonly supposed that by setting the pointer at the infinity mark on the focusing scale everything in the view will be in focus or well defined in the picture. This is not so, except in the case of open landscapes without foreground objects. For all other subjects it is well to choose some object in the near middle distance and set the scale pointer to give that object or part of the subject sharply focused. thus securing fair definition for the foreground objects as well as for those lying beyond the object selectively focused. In other words, set your scale pointer so that the definition of the picture is distributed over the near and far planes of the subject, with the emphasis of sharp definition on the plane of principal interest. This applies with particular force in scenes including figures, where carelessness may result in prominent woolly foreground masses detracting from the interest of the figures.

Depth of Focus. The problem of getting all we desire of the subject sharply defined in the picture calls for a practical knowledge of "depth of focus" or depth of field, as it should properly be called. This term expresses the ability of the lens to give a sharply defined image of both near and distant objects. Theoretically a lens can give a sharply defined image only of objects at one point or, as we say, lying in one plane in front of it. But practically we find that the lens will give a more or less sharply defined picture-image of objects somewhat in front of and behind this point or plane of critical focus or definition. The range of this distance is spoken of as the depth of field or depth of focus of the lens. This depth of field depends upon the relation between the focal length of the lens and the aperture or stop used. Thus it increases as the focal length of the lens and the size of the stop decrease. Of two lenses of the same speed, but unequal in focal length, the lens of shorter focal length will give the greater depth of focus. This explains why the pocket camera lens, regardless of the aperture or stop used, gives greater depth of field than is obtained with lenses of the same speed but of greater focal length.

Apply This to the lens on your camera, with its different apertures, by taking from the table following the line which gives the focal length of your lens in the left-hand column. Follow this line to the right, and you have the distances in feet on which to focus with different apertures. so that all objects situated beyond *half that distance* will be fairly well defined or in focus.

Another Use of the table of hyperfocal distances given above is to use it to find the precise depth of field available, with your lens and its apertures, when you focus an object at any given distance from the camera. Take any desired distance from the scale and multiply the hyperfocal distance for the lens and stop in use, expressed in

TABLE OF HYPERFOCAL DISTANCES

Focus of Lens in Inches	Diaphragm Apertures: F Values and U. S. Numbers							
	F/4 U. S 1	F/5.6 U. S. 2	F/6 U. S. 2.25	F/7 U. S. 3.06	F/8 U. S. 4	F/11.3 U. S. 8	F/16 U.S. 16	F/22 U.S. 32
	Distances in Feet							
2½	13	10	9	8	7	5	3½	3
3	19	14	13	11	10	7	5	3½
3½	25	18	17	15	13	9	7	4
4	34	24	22	19	17	12	8	6½
4¼	38	27	25	21	19	14	10	7
4½	42	30	28	24	21	15	11	8
4¾	47	34	32	27	24	17	12	9
5	52	36	35	30	26	19	13	10
5½	63	45	43	36	31	23	15	12
6	75	54	50	42	38	27	19	14

inches. Now divide the result by the hyperfocal distance *plus* the distance chosen from the scale (in inches), and this will give us the distance away of the *nearest object* which will be in focus with the stop chosen when we focus on an object at the distance taken from the scale. Again multiply the hyperfocal distance by the scale distance (in inches), and divide the result by the hyperfocal distance *minus* the scale distance, and this will give us the distance away of the *farthest object* which will be in focus with the stop chosen when we focus on an object at the distance chosen

Examples. For example, we are working with a six-inch lens, at f/8. The hyperfocal distance for this lens and stop, as the table tells us is 38 feet=456 inches. To find the depth of focus available with this lens and stop at the first distance taken from the focusing scale, viz., 6 feet = 72 inches. 456 × 72 = 32,832 ÷ 528 = 62 inches = 5 ft. 2 in. for the nearest point; similarly 456 × 72 = 32,832 ÷ 384 inches=7 ft., practically, for the farthest point. Thus, with a lens of 6

inches focus, at f/8, focused on an object only 6 feet away, the available depth is practically 2 feet. Focusing on an object 24 feet away, the depth available would be between 15 feet for the nearest object in focus, and 67 feet away for the farthest object, and so on. It should, of course, be remembered that, where the hyperfocal distance for a lens of any focal length and stop is known, then *all objects lying beyond half that distance from the camera will be in focus.*

Exposure is the third and most important term in our formula for successful work outdoors with the hand camera. In theory it is admittedly the most difficult problem in amateur photography, but latterly has been so simplified that it no longer presents any serious difficulty in actual practice.

There are three ways of finding the exposure required for any outdoor subject or set of conditions. (1) The invariable use of an exposure meter which measures the photographic strength of the light, such as the Milner Light Gauge (simplest of all), the Heyde, Haka, Ica Diaphot, Watkins or Wynne meters. Every beginner should use such a meter for some time at least. (2) By combining one's knowledge of the factors which control exposure with the use of an exposure calculator or table, such as the Harvey, American or Imperial calculators. (3) By guesswork, instinct or intuition (the method used by professionals), based on long familiarity with exposure conditions and the ability, gained by experience, to estimate the exposure required by the illumination of the subject or the appearance of the picture-image on the focusing screen (if the camera has one) at the time of photographing.

By carefully using a light meter for some little time, as suggested, the beginner will slowly but surely learn to classify his subjects and light conditions in relation to the character and speed of his plate or film, so as to be able to use the

third method outlined, and so dispense with meters, tables and all like impedimenta.

An intelligent study of the booklets which invariably accompany exposure meters and tables, or of The Photo-Miniature: Nos. 54 and 105, will give the reader a practical acquaintance with the factors which control exposure. These are: (1) The strength of the light, varying with the time of year or day, the weather and atmospheric conditions. (2) The speed of the plate or film in use, which may be made invariable by using only one kind of plate or film in every-day work. (3) The character, color and distance away of the subject photographed, and its rate of movement if the subject includes rapid movement. (4) The focal length and aperture of the lens in use. In practice these items are standardized as far as possible and considered relatively and collectively, so that the calculation of an exposure is by no means as difficult in fact as in theory. The latitude of today's plates and films, by which is meant their capacity to give good negatives within a certain margin of error in exposure, also helps to simplify the problem.

A Useful Table, covering most of the outdoor subjects which attract the amateur, and based upon a classification of such subjects into four easily memorized groups, is that given many times in *Kodakery* and republished here as one of the best I have seen. This table, with others for Kodaks fitted with single lenses, fixed focus cameras, etc., is obtainable for the asking, as a circular reprint, at any Kodak store. The table given is based upon the variation of the lens aperture and an invariable exposure of 1/25th second. Since, however, it may be preferred to work with a single aperture, such as f/11 and vary the shutter speed or exposure itself, I have added two columns at the right of the table (as given in *Kodakery*) providing this alternative.

By this latter use the amateur will get a better idea of relative exposures.

Exposure Table for Cameras with Rectilinear or Anastigmat Lenses

For 2½ hours after sunrise until 2½ hours before sunset on days when the sun is shining

	Shutter Speed	Rectilinear Lenses Stop	Anastigmat Lenses Stop f/	Stop f/	Shutter Speed
Group 1—Snow, Marine and Beach Scenes—Extremely Distant Landscapes . . .	1/25	32	22	11	1/100
Group 2—Ordinary Landscapes Showing Sky, with a Principal Object in the Foreground . .	1/25	16	16	11	1/50
Group 3—Nearby Landscapes Showing Little or no Sky—Groups, Street Scenes	1/25	8	11	11	1/25
Group 4—Portraits in the Open Shade, not under Trees or the Roof of a Porch — Shaded Nearby Scenes . .	1/25	4	7.7 or 8	11	1/10

These exposures are calculated for bright or sunny days, in winter as well as summer, and Eastman film. When the day is cloudy bright, the exposures should be twice or thrice as long, and on very cloudy days or in a dull light, from four to eight times as long as those given in the table.

Exposures With Color Filters. Since most of the plates and films used with hand cameras today are orthochromatic or color-sensitive, chiefly to the yellowish green light rays, you can improve the general quality of your work by a more frequent use of a color screen or, failing that, at least a sky screen. In both cases the effect is to depress the super-sensitiveness of plates and films to the blue and violet rays. When a light color filter or screen is used, the normal exposure required by the subject should be increased from three to five times; with a

sky filter it will generally be sufficient to double the normal exposure. It is a mistake to think that the use of a color or sky filter necessitates the use of a tripod. An exposure can be doubled by halving the shutter speed without changing the stop, e.g., giving 1/10th second instead of 1/25th second with the same stop, or by doubling the area of the stop without changing the shutter speed, e.g., using stop f/11 instead of f/16 with the same shutter speed. By this sort of modification of stops and shutter speeds, it will often be found quite practicable to use color filters for exposures made with the camera in the hands. For example, I have frequently obtained very satisfactory pictures of open landscapes, with fairly dark objects in the middle distance and skies well filled with clouds, in September and October, at 3 P. M., using a sky filter and the lens at f/16, with exposures of 1/25th second. In spite of which there can be no doubt about the wisdom of carrying and using a tripod wherever this seems desirable in hand camera work, as in all cases where the subject does not include movement. This makes for more careful composition, both as to spacing and light and shade, more ample exposures and better negatives, resulting in more pleasing enlargements.

Holding the Camera. Far too many of the beginner's failures result simply from lack of skill or drill in holding the camera correctly and steadily during the exposure. This is a small detail, but vital, and should be mastered in the beginning. The slightest movement of the camera during exposure means either a sloping horizon, inclined vertical lines in buildings, displacement of the image or blurred definition. The finest lens, the most careful focusing and expert shutter handling, will be all unavailing to secure a good photograph unless we have learned how to hold the camera steady while making the exposure, and proficiency in this

respect is the more necessary the slower the speed of the shutter and the lighter the camera. As full exposure of the plate for the average subject means a shutter speed of 1/20th to 1/40th second, and as the general preference is for a light folding camera, it is necessary to give attention to this point in camera drill.

First, it is desirable, where possible, to hold the camera firmly against some support if the exposure is to be longer than 1/25th second. By practice it is possible to hold the camera steady for exposures of 1/10th to 1/15th second, but this skill is rare. If a post, fence, tree, or angle of wall can be found, all the better. If one is not near such aids, then the body is used. Just where the camera ought to be pressed against one's person depends on the subject. If very near and rather low down, e.g., a figure or animal, the camera ought to be held level at about the middle of the height of the subject, not pointed downward. For this purpose one knee may be placed on the ground and the other caused to form a supporting table. For average subjects the waist-level is more convenient, and here, with a bulky or heavy camera, a great aid is to sling the camera by a light strap going around the neck, and to keep it steady by a slight downward pressure. Pressure of the camera against the chest is good position, whilst a very firm support is secured by pressure against the chin or lips.

If a direct-vision view-finder is used (at eye-level) then the camera back can be held steady against the eyebrow or cheekbone. Bear in mind that one can overdo the pressure business; pressure can be maintained so tightly that it becomes almost convulsive and defeats its very object. Just hold the camera firmly, but with some elasticity, and, if it is held against the chest, make a habit of holding the breath for the instant

of exposure. All the better, too, if this instant comes when the lungs are deflated.

Photographing Over a Crowd. When working in a crowd, as at automobile races or the like, it is often advantageous to be able to make your exposures with the camera held up over the head. This is not an easy thing to do successfully, but the knack can be had by preparatory drill. The results are worth the trouble and ability to make exposures this way without movement, holding the camera well up above the head and looking up into the finder-mirror, will oftentimes give you a print that will bring a good price.

Releasing the Shutter. A very necessary item in camera drill is to learn how to hold the camera so that while the hand used to release the shutter supports and steadies the camera, a finger or thumb is free to press the lever releasing the shutter without any movement of the hand or the camera. The movement should be independent in the finger or thumb itself, and this independent movement can be made sure only by practice, the hand as a whole steadying the camera not only as to the weight and bulk of the latter but also as against the independent movement of the finger or thumb pressing the lever of the shutter.

Height of the Camera: The effectiveness of an outdoor scene depends very largely upon the height of the camera. This directly controls the amount of foreground and sky included in the picture. Try this experiment for yourself with an average subject. Expose film No. 1 on the subject at about 18 inches from the ground, supporting the camera on one knee; expose film No. 2 with the camera in its normal position about the waistline; film No. 3 should be exposed with the top of the camera at eye-level, the subject being sighted from the center of the back of the camera between the two front corners or lens-board uprights. The height of the camera in

photographing near objects is especially important with such subjects as a figure standing near a bush or shrubbery. Here a low viewpoint will give the figure greater height, while the eye-level or waistline-level view will often merge or dwarf the figure in relation to the nearby bush or shrubbery. Try a standing figure on an elevation with a background of sky and you will get a valuable lesson in this important detail. Similarly, in photographing a winding stream or river, with a bridge as prominent feature in the middle foreground, try the different effects gained by varying the height of the viewpoint from which the exposure is made. And, in the case of a very tall building on a narrow street, there is often an advantage in photographing from a nearby window or similar point of vantage one or two stories above the street level. In like manner, where the subject is an outdoor scene including figures, choose such a height for the camera that the top of the figures will be on the level of the eye for the most pleasing effect.

Leveling the Camera is a little, but important detail too often neglected in hand camera work out of doors, with disastrous results. Buildings and street views in which the vertical lines converge or lean unpleasantly, or which have large, empty foregrounds and all the interest of the view crowding out of the top of the picture; seascapes with sloping horizons; landscapes or open views with overmuch sky or foreground; and a general lack of proportionate spacing of the parts of the picture: all these faults result from not holding the camera level at the moment of exposure.

The remedy is to use a level on your camera whenever the subject includes vertical or horizontal lines, or as an aid in the correct spacing of the picture as to the position of the horizon line. Lacking such a device, a black line ruled across the face of the finder will help to keep the horizontals in the picture straight and level as in the

subject itself. Sometimes it is possible to "sight" along the side of the camera and so ensure true verticals. If the camera is tilted up in order to include the top of a tall building, the lines will converge in the negative, unless the sliding front movement is raised. How far to raise the front to overcome this divergence of the lines is a difficult point to determine, as the image in the finder does not show the effect of raising the camera front. The problem is, however, completely solved in an ingenious device known as the O. D. D. (optical divergence determiner) invented by Mr. A. Freeman, a hand camera enthusiast of the old school who believes in good technical photography. With this attached to the camera one tilts the camera to the degree necessary to include the building or amount of sky desired, reads the scale on the O. D. D. and then raises the lens board to the degree indicated by the scale. This gives true verticals and a correct spacing of the parts of the picture in a much simpler way than by the use of a level and guessing as to how far to raise the lens board.

Shade the Lens. Among amateurs who have graduated from the simple Brownie to a more expensive hand camera fitted with an anastigmat, one often hears complaint of flat, lifeless negatives, lacking brilliancy or "snap" in definition and detail. In many instances this "fault" is imputed to the lens, but generally it is due to a careless use of the lens. First, it is not always a fault. Where this softness or indistinctness of detail is due to atmospheric conditions at the time of photographing, as in autumn or winter subjects, early morning scenes with ground mists, or the light fog of city streets, it is not a fault at all, but a natural and desirable feature of the scene. So, in much outdoor work, where pictorial effects, aerial perspective and recession of planes are striven for, this atmospheric envelopment is most desirable.

In record photography, however, where a clear and brightly defined picture-image is needed, lack of crispness or brilliancy is a fault and should be

remedied. It may often be traced to light scatter, glare or reflected light inside the camera, due to light reaching the unprotected lens surfaces from all directions. Because of the extreme compactness of many hand cameras, the lens is often mounted flush with the camera front, i.e., without a protecting flange or hood to shield the front of the lens.

The remedy is obvious. Shade the lens during the exposure. For this a lens hood or lens shade is advised. Any device which will shade the lens from excessive light impact without cutting off any part of the subject will serve this purpose. For the small folding hand cameras of today, the most convenient lens shade may be made from a strip of black felt, cut as a segment or arc of a circle, half an inch longer than the circumference of the lens flange on which it is to be fitted, and sufficiently wide to shield the lens without cutting off any portion of the lens field. A couple of dress snap fasteners will hold the hood in place on the lens and the device can be folded and carried in the pocket when not in use.

Picture Making out of doors with the hand camera becomes vastly more interesting in the doing and in the results if the reader will keep his eye open for the unusual aspect of the commonplace subject. Take, for example, a valley stream. It may be that by climbing a few hundred feet you can get a bit of jutting foreground, below which the stream will wind in curious curves in the valley below. Or take the summer girl on vacation. Instead of picturing her on the steps of the porch, or against an old wooden gate, or looking coy against a background of shrubbery, select a bit of high or rising meadow ground, let her pose carelessly for the standing figure, go back about 15 feet and kneel, resting the camera on one knee pointed at the girl. Select the viewpoint so that the figure will stand out against the sky as if on a mountain top. If the figure is out-

lined against a low setting sun, so much the better. Rest the camera easily and give an exposure of at least 1 second at $f/8$.

Two Helpful Rules. The pictorial value of your outdoor work can be directly increased by simply remembering these two rules and following them as closely as the subject will permit. First, avoid lights spots at or near the margins of the view; try to get the highest spot of light a little to either side of the center of the picture space. Second, whenever it is possible choose a viewpoint which will give you almost equal amounts of light and dark distributed through the picture-space. Mentally divide the picture-space by a diagonal line from the upper right to the lower left corner. Let the predominant dark masses be in the right-hand diagonal and the dominant light-masses in the upper diagonal. A dark spot at the lower left-hand corner will usually complete the balance of a composition so arranged.

Simplify. The first step in the way of making pictures instead of mere snapshots out-of-doors is to think what you can leave out of the scene before you make your exposure. The average snapshot includes far too much of the subject in front of the lens. Prove this to yourself by going over a few of your outdoor negatives, and see whether there is not a little bit in almost every negative which would make a more interesting picture or one more "worth while," if all the rest of the film were trimmed away. You can emphasize this lesson by enlarging an average dozen of your outdoor negatives to one uniform size. Looking carefully over the enlargements, you will see quite plainly that they all need or will stand a good deal of trimming or cutting away, so as to emphasize or give more prominence to the chief interest in the scene.

Avoid Wide Range Views. The average landscape, as seen by the eye, is chiefly interesting or beautiful by reason of its large masses of color

contrast, its bigness or sense of space, and the variety it presents in form and light and shade. To portray such a scene within the narrow limits of the average hand camera size, losing all the sense of space and color, and rendering the subtle harmony of nature's color contrasts by inharmonious contrasts of light and shadow, will usually result in a maplike record lacking charm and interest. It cannot be otherwise in the great majority of instances. Natural scenes embracing a wide expanse rarely lend themselves to the making of small reproductions possessing pictorial interest. Leave them to the panoramist and learn to see pictures in the little bits of nature on every hand. You can learn this lesson from a careful survey of the pictures shown at any exhibition.

Foreground Shadows. The emptiness of the foreground is an outstanding fault in the majority of the amateur's snapshots. It can easily be remedied by taking thought beforehand and so arranging that the point of view and illumination will give a pleasing shadow design upon what would otherwise be a monotony of even tone in the foreground of the picture. Of course, care should be exercised that the shadow design introduced is not "noisy" or so obtrusive as to attract attention from the chief interest of the scene or subject of the picture. The best shadow designs are such as are not too pronounced in pattern or tone, the object being to fill an otherwise empty space decoratively and, by the disposition of the design, to lend support and interest to the principal object of interest. Thus in a street scene, where one side of the street recedes in oblique perspective, the faint shadows of the buildings opposite may be used to contribute pleasing tone masses in the immediate foreground; in a view of a roadside inn or of a country road, the interlacing shadows of trees will often provide decorative variety in the foreground. In harbor and marine scenes reflections afford a ready means of

adding interest, while in beach and snow scenes, the old trick of breaking up the foreground with a curved track of footprints (if not too obviously done), will sometimes save the picture. Forethought and moderation are all that is necessary. Sometimes a dark area in the foreground will help to lead the eye into the picture and emphasize the main point of interest; at other times the lines or masses of the shadow design may be used to give depth, and so on. Look at your composition as a whole, and if the foreground would be improved by the introduction of a tone design, consider well what will help and set about its inclusion in such a way that the unity of the composition is strengthened rather than weakened.

Street Scenes. Many street subjects are spoiled by the figures which are included. It is certainly wiser to err on the side of too few than too many figures. But one need not therefore fly to the extreme of no figures at all, which is apt to give a "deserted village" appearance. Most street-scene show one or other of the following undesirable features: (1) Figures staring at the camera; (2) too many figures disconnected or in a large number of small groups, between which there is no apparent relation; (4) near figures too large for the proportion of the picture: (5) near figures and distant figures showing very marked difference of size, suggesting exaggerated proportions. Look out for awkward conjunctions of forms, such as a lamp-post or electric light standard in the middle distance, apparently resting on the head of a prominent figure in the view. This applies also in outdoor portraiture. Watch carefully the shapes of things behind the figure. I recall a delightful portrait of a girl, seated on a boulder on a hillside, with a group of fuzzy bushes or shrubs sprouting from the top of the girl's head—at least so it seemed.

Figure Work. The common error is to attempt to get large figures in outdoor portraits. It is

better to get a good result on a small scale than a faulty figure picture on a large scale. You can always enlarge the small figure or group if it is worth enlargement. Remember that the nearer the figure is to the camera, the larger its image is on the plate and the longer is the exposure required. In outdoor figure work including movement, the nearer the figure, the greater is its apparent movement on the film during the exposure, and so the greater risk is there of blur in the picture or under-exposure if you attempt to shorten the exposure to "stop" the movement.

Harbor Scenes. Sailboats, fishing or lobster-boats and small shipping such as are found in most harbors at seashore resorts offer simple subjects for the hand camera. Here the subject is generally some little distance away from the camera, so that we can focus for infinity and feel pretty confident that the picture will be sharp all over with the full aperture of the lens. The subject is naturally a light one, heavy shadows in the foreground are almost sure to be absent. Moreover, although the vessels may be moving rapidly, they are sure to be at such a distance that the movement of the image on the plate is not rapid, so that an exposure of 1-25th second may be given without fear of blurring. In fact, with subjects of this kind, the movement is so slight that it hardly has to be taken into consideration at all.

Lake Views. A lake generally means a fairly large expanse of calm surface water. We may or may not have it surrounded by hills. But while skylight may be cut off by the hills, yet we have the reflecting effect of the water surface. Pictures wherein lakes, large ponds, wide-open rivers, and other large masses of water occupy any considerable part of the foreground division of the picture are among the cases which call for very great care and circumspection as regards point of view. Meanwhile the hand camera man may

be wise in accepting a word or two of general advice. (1) Do not let the lake or other open water extend from one side of your picture to the other. (2) Do not have much picture space occupied by calm water. (3) Avoid bright patches of water close to dark rocks, tree trunks, etc.; such strongly marked contrasts of light and shade are not likely to be very pictorial. If the edge of the lake is fringed with heavy foliage, remember the rule to expose for the shadows and let the high lights come as they will.

Birds' Nests. An attractive outdoor subject, in which the amateur generally fails, is the photographing of birds' nests. Contrary to common belief, this subject is one which calls for a long exposure and a small stop. First, carefully fix the camera by tying it to a nearby branch or other vantage-spot giving a pleasing view of the nest and its possible contents. Stop the lens down to *f*/16 to secure detail and give an exposure of from 1 to 3 seconds carefully counted. You may have to wait half an hour in order to secure perfect stillness, that is, freedom from wind-movement or the swinging of the branch carrying the camera. Of course, a portrait attachment will generally be used on the hand camera for such a subject as this. If there are young birds in the nest, then it must be well lighted, as the exposure cannot exceed 1-5th second with the lens wide open without risk of blur or movement.

Glens and Ravines. A few weeks ago an amateur came to me, with loud complaining, to ask why he could not get any better snapshots of a wooded ravine with his $53 camera than he had previously obtained with a $3 fixed-focus box camera. Had he not paid heavily for speed in buying his expensive outfit? Yes. But the wooded ravine, like the dimly lighted forest glen or old cathedral interior, is not a snapshot subject. It has large masses of dark shadow with contrasty light spots and great depth from nearest to far

detail. These conditions call for a small stop, to secure desirable depth of definition, and a long time exposure (tripod) to record the extreme contrasts of light and shade in their true values. With such subjects charming effects may sometimes be obtained when the sun is not too high, but as a rule a cloudy day, or one when the sun is hidden behind light clouds, will give more pleasing pictures. A tripod and a time exposure are, as I have said, essential, and the best negatives will be obtained before 9 a.m. or after 4 p.m. In spring or autumn a color screen or a self-screened plate will generally give better values. The exposures will range from six seconds to half a minute or more, at *f*/22. Thus I have given woodland scenes 10 seconds exposure, with stop *f*/64 at 9.30 a.m. in September, 5 seconds, at *f*/32, after 4 p.m. in early August, and 40 seconds at *f*/32, at 4 p.m. in October. The apparent depth in such a scene is heightened if it is possible to include a not too large dark object in the foreground, placing the highlights higher up in the scene. If it is an unusually rugged and rocky ravine, with a tiny stream of water tumbling through, and something darkly romantic is desired; then put aside all that is said above and boldly make a snapshot with the sun almost overhead. This will give you the boldly outlined masses just touched with light and, possibly, the pictorial effect sought.

Camp Scenes. Interesting records of camp life, with figures, including oneself, are easily possible with a hand camera used on a tripod. We will suppose the tent is to serve as a background and that the group has been arranged to our satisfaction about the open entrance to the tent, with a vacant place for yourself in the group. Focus the scene carefully to get a pleasing arrangement, and then drive a post at the point from which you have focused the scene. If you can focus from a nearby tree in front, so much the better. The

camera is now firmly attached to the post or tree at the point from which the group was focused. The lens and shutter are set for an exposure of 1 second with *f/22* (U. S. 32), and a sufficient length of thin string is tied to the shutter release and led into the foreground of the scene up to the seat you propose to occupy in the picture. Everything being ready for the exposure, take your seat and, placing one foot lightly over the string attached to the shutter, pull the string gently at the right moment, release the shutter, and make the exposure. If a little skill is used, this device will give a pleasing picture without mishap or failure.

Winter parties are good subjects for daylight work with the hand camera. Remember the nearness of the figures and the dark clothing against the light background of snow. Use a tripod and give a generous exposure in order to get agreeable values in your picture.

From Trains. Photographing from a train, steamer, or other moving object is not altogether easy, but by watching for a favorable moment some very interesting records of a journey may be obtained in this way. Do not attempt to photograph any subject within 100 feet of the camera. Set the pointer of the focusing-scale at the 100-feet mark and the shutter at 1-50th second with the lens at *f/16*. A bright or sunlit day is presupposed. Rest the camera securely on the ledge of the car window if in a train, or balance yourself securely on both feet if on the deck of a steamer, and as the train rounds a curve or passes a picturesque bend in the river or slows up in going over a viaduct, release the exposure shutter. An angle of about 30 degrees to the direction of travel, preferably pointing back, should be chosen for the camera. Success will depend chiefly upon the combination of a favorable lighting of the subject, choice of viewpoint, and quickness and certainty of manipulation at the right moment.

Day or Night Effects from the same negatives

may be obtained very simply as follows. Snow scenes, with the strongest lights in the foreground or near the horizon, offer the most suitable subjects, and the exposures should be made within two hours after sunrise or in the late afternoon to secure long shadows. A light color screen is advised, in order to cut down the brightness of the blue sky, and the exposure, for the average view whose nearest object is thirty feet or more away, should be (Jan.-Feb.; 8-9 a.m. or 3-4 p.m.) one-fifth second with $f/8$ or three seconds with the smaller stop on an inexpensive hand camera, both these exposures calling for a tripod or other support for the camera. Do not push development too far, but keep the negative thin and detailful. To obtain day effects, print on a paper giving soft effects, timing the exposure to secure detail in the half-tones and lighter shadows. For night effects use a more contrasty paper, printing so that the details will show in the highlights only, with the shadows quite dark.

Snow Scenes. Remember that in all winter scenes with snow and a clear blue sky, the sky should appear in the print as darker than the snow. To secure this difference in values use a light color filter. When such a filter is used, the exposure may be the same as that given an open landscape in summer, with the same stop; if without a filter, give the same exposure but use the next size smaller stop. For a snow scene with a sunlit foreground broken up by shadows or a roughly trampled pathway, an exposure of one-fifth second (tripod) at $f/16$ and with a light color filter will give a soft negative, showing detail in the shadows with the crisp whiteness of the snow in sunlight.

Winter Landscapes. Pictures of snowclad landscapes, with houses, groups of bushes or brooks, or with figures (without movement), can be made with any hand camera between the hours of 10 and 3, with 1-25th second exposure at stop $f/16$

or 1-5th second exposure at stop *f/32.* If nearby and distant objects are to be reasonably in focus, use the smaller stop and set the pointer at 25 feet on the focusing-scale of the camera.

A cloudy day after a heavy fall of snow is about the most unfavorable time for winter work out-of-doors. Either there will be no shadows or the shadows will be weak and flat, and the lack of detail in the snow will add to the desolateness of the scene and suggest the dreary side of winter. Wait for a glint of sunshine or get some shadows into the composition to brighten up the general effect of the scene.

Winter Foregrounds. In most snowscapes the blank foreground of white snow robs the picture of half its charm. Whether the sun is behind or in front or at one side of the camera, this effect can be remedied by the choice of a viewpoint which will give a pictorial arrangement of shadows of nearby trees or similar objects slanting across the otherwise blank foreground of white snow.

The common device of breaking up a blank foreground by trampling through the snow, thus making some sort of path or track, has been overdone and should be avoided wherever possible.

Notes and Comment

The 1923 Exhibition of the Royal Photographic Society and the London Salon of Photography, held during September and October, are both reported to have equalled any previous "Royal" and "Salon" in the quality of the work shown and diversity of interest. A review of the salon, by F. J. Mortimer, appeared in *The Amateur Photographer* of September 12, while reviews of both Salon and Royal exhibitions were published in *The British Journal of Photography* for September 14th and 21st, from the pen of F. C. Tilney. Many reproductions of the exhibits at the Royal Exhibition may be seen in the Exhibition Number of *The Photographic Journal* (London). I refer the reader to those reviews since it is quite impossible to deal with these two important exhibitions in detail in my limited space. Over a thousand exhibits were submitted to the judging committees at the Royal, of which about 126 prints were hung in the Pictorial Section, American pictorialists being fairly well represented. At the Salon, which is restricted to pictorial photography, about 400 prints were accepted, from 178 exhibitors working in almost all the countries of the world. Among these Salon exhibitors were 46 American with 85 prints accepted, a very pleasing proportion. A selection of the Salon pictures will, as usual, be reproduced in the forthcoming volume of *Photograms of the Year* which will be ready, I am informed, early in January, 1924.

Dallmeyer Lenses. In the new catalogue just issued by J. H. Dallmeyer, Ltd., London, I note that the Pentac, F:2.9 is now available in focal

lengths from 1½ to 12 inches, for plates or films of all sizes up to 5 x 7 inches, and in mountings suitable for use in reflex cameras. The Dallmeyer Soft Focus anastigmat F:4.5 is another recent introduction described in this latest list. Doubtless full particulars concerning either series can be had from the American agents for Dallmeyer lenses, Herbert & Huesgen Co., New York.

An Australian Salon of Photography, international in scope, is announced to be held at Sydney, N. S. W., from April 22nd to May 3rd, 1924. The last day for receiving exhibits (prints mounted or unmounted, but not framed) is March 18th, so that intending American exhibitors should mail their prints without delay. The Secretary is J. G. McColl, Box 298, P. O., Sydney, N. S. W., Australia.

Contessa-Nettel Cameras. At the recent International Photographic Exposition held at Turin, Italy, the highest honor (Grand Prix de Luxe) was awarded to the Contessa-Nettel hand cameras, regular, stereoscopic and focal-plane, for excellence of design, precision and general quality. This recognition, won in open competition with the world's camera makers, is a big feather in the cap of the Contessa-Nettel firm.

Which reminds me that the most alluring pocket camera I have seen lately was a new model of the Cocarette (No. 1 de Luxe) recently shown to me by G. Gennert, the American Agents for the Contessa-Nettel line. Fitting the coat pocket or ladies' bag, for pictures 2¼ x 3¼ in., this dainty instrument was covered in russet leather with aluminum overtrim, and had the softest of leather bellows; Zeiss Tessar F:4.5 lens and Compur shutter with speeds to 1-250th second; the patented film frame (which keeps the film taut and

flat at all times) and the side loading device peculiar to the Contessa-Nettel roll film cameras. All the various adjustments of this camera were in keeping with its style and worked with the utmost smoothness and accuracy. "Built like a watch" best describes it; beautiful to the eye, and well calculated in every detail to give the satisfaction and pleasure which a good watch gives in daily use.

The Art Center, New York, inaugurated its activities of the coming year in October, with an exhibition of "Printed Pictures: How They Are Made," a co-operative effort by the seven societies of the Center. The exhibition, was the most comprehensive and certainly the most interesting event of the kind ever held in America. The various collections of originals and reproductions on exhibition were grouped in two classes: non-photographic and purely photographic methods. These were arranged in historical order, beginning with the work of the XIV century and coming down to the newspaper illustrations of today. The color reproductions naturally occupied the center of interest, but the black and white work made a strong showing and held its own in an unmistakable way. The assembling and arranging of so large and diversified an exhibition must have involved a tremendous amount of labor and enthusiasm on the part of those responsible for this work.

The photographic section, for which Ira W. Martin should have a word of praise, occupied the gallery of the Pictorial Photographers of America, and gave a fairly complete survey of the progress of photography. It included specimens of the Daguerreotype, Calotype, Ambrotype, Woodburytype and other early processes. Among these was an 8 x 10 Daguerreotype portrait dated

1858, which made a splendid showing alongside a portrait similar in size and treatment, by Pirie MacDonald (1923). In the face of the extravagant praise of the Daguerreotype during recent years, I confess that MacDonald's portrait seemed to show that photographic portraiture has made progress in the right direction since the passing of the Daguerreotype. Other exhibits of interest included a copy of that rarity, Fox Talbot's "The Pencil of Nature," the first book illustrated by photography, published in 1844 (from the collection of Stephen H. Horgan); an example of the work of H. P. Robinson; a copy of the first portrait (Dorothy Draper); and specimens of early cameras and lenses. The modern work shown on the walls comprised a small but choice collection of prints by the printing processes of today.

A Photographic Cyclopedia for a Dime! George Murphy, Inc., 57 East 9th Street, New York, send to my table a copy of their Mail Order Catalogue No. 123. It is an extraordinary bit of work in its completeness, arrangement and illustrations, and may fairly be called a cyclopedia of photographic information. The painstaking labor involved in its making must have been prodigious. It has 200 pages of small type and over 400 illustrations, listing, describing and showing every variety of photographic apparatus and materials obtainable in the American market, plus a host of imported specialties. It is arranged in alphabetical order, so that you find Acetylene Burners and Airbrushes right at the front, and Washing Machines and X-ray Plates at the end, with all the other things in between, under their alphabetical letters. An amazingly interesting and useful book. You can secure a copy for your bookshelf by sending ten cents to cover postage.

Books and Prints

All books mentioned in these pages may be obtained from the Publishers of THE PHOTO-MINIATURE **and will be forwarded promptly, postpaid, to any address on receipt of the prices quoted.**

PHOTOGRAPHY AS A SCIENTIFIC IMPLEMENT. A Collective Work, Giving an Authoritative Account of the Photographic Methods Employed in Observational Scientific Investigation. 549 pages, with 258 figures in line and halftone; 6 x 9 in. Cloth, $9. London. 1923. New York: Van Nostrand.

This is a bulky volume, beautifully printed and profusely illustrated. It is made up of fourteen contributed papers by thirteen experts; deals with the theories underlying photographic processes, and gives a detailed account of the technical methods employed in the applications of photography in scientific and industrial research. Apart from the vivid interest of the summaries given of the results achieved in the several uses of photography dealt with, the lucidity of its explanation of the theories and principles involved, and the practical usefulness of the methods described, fairly entitle the work to rank as the photographic book of the year. The photographer who desires to keep abreast of the progress of photography, as well as the specialist seeking specific information about advanced technical methods, will find this book a profitable investment and wholly satisfying.

The volume begins with a chapter on the historical evolution of photography, the only feature of the book which could well have been dispensed with. It is, however, apparently intended, with chapters two (The Elementary Optics of Photography), three

(Photographic Optics) and four (The Theory of Photographic Processes and Methods), to serve as a groundwork for an intelligent understanding of the practical applications discussed in the later chapters. Be this as it may, the brilliant monograph on the theory of photographic processes and methods, by Dr. S. E. Sheppard, comprising chapter three and covering over a hundred pages, is the best summary of our present day knowledge of the physics and chemistry of dry plates and printing papers within my knowledge, and well worth the price of the book.

The titles of the chapters following the first four sufficiently explain the contents of the book. They are Astronomical Photography; Application of Photography in Physics; Photography in the Engineering and Metallurgical Industries (chiefly photo-micrography): Photo-micrography (apparatus and methods); Photographic Surveying; Aeronautical Photography; Color Photography; Photography Applied in Printing (Graphic Arts); The Technics of Kinematography; The Camera as Witness and Detective. A Supplement of 25 plates and a comprehensive index complete the volume.

THE AMERICAN ANNUAL OF PHOTOGRAPHY 1924. Volume XXVIII. Edited by Percy Y. Howe. 296 pages; 175 illustrations, with 24 plates in color. Paper covers, $1.75. Cloth bound, $2.50. New York: Murphy. [Postage 15 cents additional.]

First of the 1924 annuals to reach my table, this new issue of an old favorite offers a goodly store of interest and illustrations. Mr. Howe has been unusually successful in securing contributed papers of everyday usefulness, covering a wide range of photographic work. The review of the year's progress is well done, and the articles dealing with telephotography, mountain photography, photo-micrography and carbro printing in one, two and three colors are especially interesting. The list of illustrators includes many well known pictorialists:

Ruzicka, Basil, Murray, Zerbe, Eickemeyer, Kilmer, Alcock, Sophie Lauffer, Laura Gilpin, etc. The permanent features of the Annual, such as its Standard Formulary, List of American Photographic Societies, Calendars and the like, have been revised to date and round out an interesting and useful book.

The Complete Photographer. By R. Child Bayley. 7th edition, 1923. 420 pages; 65 plates. Cloth, $5. New York: Stokes.

To my mind this is the best all-round handbook in the English language for amateur photographers; the most carefully considered in the statement and treatment of its subject; the most interestingly written and the most inspiringly illustrated of photographic books. Obviously it is intended for the serious worker, rather than for the beginner who wants a formula or diagram on every page. This being understood, the book is one which the progressive amateur will read and re-read with increasing pleasure and profit.

The first edition, if I remember rightly, appeared about 1907. The seventh edition, here noticed, shows steady growth in bulk, having been revised and, in part, rewritten to include the ideas and methods current in the photography of the last few years. The twenty-six chapters cover every phase of photographic work likely to attract the ambitious amateur, and the sixty-five plates are selected examples representing many famous photographic workers of widely different schools of photography.

The Origins and Development of Pictorial Photography are beginning to receive attention. There is an interesting chapter on the subject in "The Principles of Pictorial Photography," by John Wallace Gillies, published a few months ago, and in the December issue of *The Photographic Jour-*

nal (organ of the R. P. S.) the presidential address of the year, by Mr. J. Dudley Johnston, deals with the same topic. From the two contributions one may get a clear and succinct account of the movement. Mr. Gillies deals more directly with the modern phase of pictorialism which began at Vienna about 1891. Mr. Johnston confines himself to the work of the British and Americans, with special mention of the work of Alvin Langdon Coburn, Edward Steichen, and Clarence H. White. It is worth noting that in both accounts Alfred Stieglitz is recognized as the one outstanding figure in pictorial photography, and the most vital factor in its progress and achievements.

THE PRINCIPLES OF PICTORIAL PHOTOGRAPHY. By John Wallace Gillies. 253 pages; 76 plates. $3.50. 1923. New York: Falk.

Those who know Gillies, or are familiar with his viewpoint on men and things photographic, will open this book of his with a keen anticipation of something different. They will not be disappointed. There have been many books about pictorial photography since H. P. Robinson brought forth his classic, "Pictorial Effect," away back in 1869, before most of us had seen the light of day. But Gillies has given us a discussion of the subject which is different from and, in my opinion, better than all the others. I mean "better" in that he does not dogmatize, or rehash, or beat about the bush as some have done, but goes right to the point in every chapter and makes one think for oneself—which means a good book.

The volume is unique in its make-up. After an "Appreciation" and an "Introduction," it begins with a series of "Statements," wherein Clarence H. White, Dr. A. D. Chaffee, Edward Weston, O. C. Reiter, Alexander P. Milne, W. H. Porterfield and Nickolas Muray give their notions about pictorial photography. Follows a Gillies definition of "The Picture", filling a whole chapter, with which one

may agree or disagree at will. The History of Pictorial Photography, from D. O. Hill, Julia Cameron, Rejlander and the other early workers to the last International Salon at New York in April, 1923, has a chapter to itself. Apparatus and Technique; The Subject; Making the Picture; and Composition are then discussed, after which the author makes a sensational finish by dissecting and discussing the seventy-six illustrations by more or less famous pictorialists (including Gillies, of course), which are interpaged with the text.

The illustrations are well chosen, afford a glimpse of many recent exhibition prints faithfully reproduced, and give point to some of the startling things set forth in the text. It is a book which every pictorialist, aspiring or "arrived," should read with profit and enjoyment.

The British Journal of Photography Almanac, 1924. Sixty-third Issue. Edited by George E. Brown. 806 pages, with photogravure frontispiece. Paper covers, $1; Cloth, $1.50. London: Greenwood. American Agents: George Murphy, Inc., New York. [Postage, 25 cents additional.]

The value of the "B. J. Almanac" as a digest of useful photographic information, epitome of progress and treasury of helpful references, formulas and tables for photographers stands out at the end of a dull year, such as 1923 has been in photography. As the Editor confesses in his "Preface," the advances made during the year are few and far between. Nevertheless the reader will find the "Almanac" as interesting and as indispensable as ever. The leading feature is a series of practical notes on "Using a Hand Camera." This is followed by a condensed record of the events of the year; new apparatus and equipment; photographing various subjects; negative processes; printing processes; color photography; a list of the photographic journals of the world (strangely enough, omitting The

Photo-Miniature); standard formulas for the principal photographic processes; a brief history of photographic and photomechanical processes; and a very complete collection of chemical, optical and exposure tables, revised and brought down to date. To top the feast the book is provided with no less than three indexes, and gives in its 450 advertisement pages a very comprehensive survey of the staples and specialties in apparatus and materials offered by the photographic trade of the four continents.

The Real Pictorialism: Being the First of a Series of Tracts for Pictorial Photographers. By F. C. Tilney. 32 pages, with 4 illustrations. London: Greenwood. [50 cents.]

Out of the paper on "The Feud Between Painter and Photographer," read by Mr. Tilney before the Pictorial Group of the R. P. S. last March, has grown this trenchant discussion of "The Real Pictorialism," in which Mr. Tilney sets forth the vital difference between "artistic photography" and "photographic jugglery" on the one hand, and "pictorial quality" on the other. It is well done. There is no mincing of words or softening of judgment. The leaders of the old pictorialism are put in their places. The big question: "What is a picture?" is met with a definite answer which the aspiring pictorialist should engrave on the tablets of his heart. I am tempted to quote from every page, but the booklet needs to be read as a whole to appreciate the force and significance of its keen thrusts and robust statements of common-sense facts.

Practical Amateur Photography. By William S. Davis. 245 pages, illustrated. Cloth, $2. Boston: Little, Brown.

Mr. Davis is a painter and etcher of repute who, for some years past, has followed photography as an amateur. His illustrated papers on his hobby have

appeared in many of the American journals of the last few years. In this handy volume he has gathered the fruits of his experience in photography and its processes, covering practically the whole range of amateur work and providing a well-digested mass of useful information. To each chapter is appended a list of bibliographical references, which should have included every number of The Photo-Miniature, but fails in this important detail. A glossary of photographic terms is given at the end of the volume.

Blue Printing and Modern Plan Copying. By B. J. Hall. 130 pages, with 65 illustrations. 1921. $2. New York: Pitman.

Considering the widespread use of blueprints in engineering, architectural and industrial work generally, there is a dearth of information dealing with the making of modern copying papers and their use. This English handbook will therefor be welcomed by those who employ these copying methods. It is obviously written from practical experience with the processes described, and the illustrations add to the value of the information given. It covers copying with the camera (Photostat, etc.); the equipment of the photo-printing plant, blue-printing machines, etc.; the handling of various light systems; the exposure, development and finishing of different kinds of copying papers; the "true-to-scale" and ordoverax methods; and ends with a good chapter on the preparation of drawings for photo-engraved line blocks. It is regrettable that the author did not include a few reliable formulas for the manufacture of the papers described, as to which detail the little handbook by Friese, published in 1919, is more satisfying than the work here noticed.

Photography for Beginners. By George Bell. 123 pages. Cloth, $1. 1923. New York: Stokes

This little handbook follows its title very closely, giving in simple words and diagrams a straightforward account of how a photograph is made; how a camera works; how to select an outfit; exposure, development and printing and so on, from the beginning to the end of the amateur's first year's work in photography. It is just the book to put into the hands of the high-school boy or girl when they purchase their first camera, and should be included with every photographic outfit sold at $10 or less.

Perfect Negatives and How to Make Them. By Dr. B. T. G. Glover. 71 pages. Liverpool: The New Photographer. [50 cents.]

In this handbook, somewhat resembling the early issues of The Photo-Miniature in size and appearance, Dr. Glover gives the beginner a thoroughly practical and well-reasoned guide to negative making from A to Z. The writer is an authority on the technical side of photography, and the methods and formulas given are representative of the latest and most approved practice.

Byepaths of Color Photography. By "O. Reg", edited, with an introduction, by William Gamble. 124 pages; frontispiece in colors and 45 diagrams. Cloth $2.50. New York: Dutton.

This book, published in England two or three years ago, is at all events honestly labeled, since it is of interest only to those who have traveled along the byepath of one-exposure three-color photography, which lies well off the main road through that field. Within its narrow scope, however, the volume offers much curious and suggestive information about the patents, apparatus and methods introduced during the past half century for obtaining three-color records with one exposure, and should not be overlooked by the student.

TITIAN

TINTORETTO

VERONESE

RUBENS

Miniature transcripts of works by Titian, Tintoretto, Veronese and Rubens referred to in the text pages.

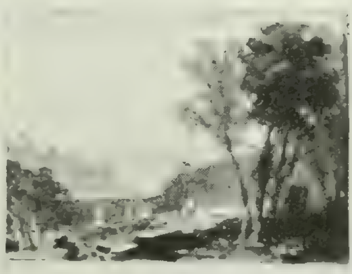
REMBRANDT

VANDYCK

CLAUDE

VERMEER

REYNOLDS



TURNER

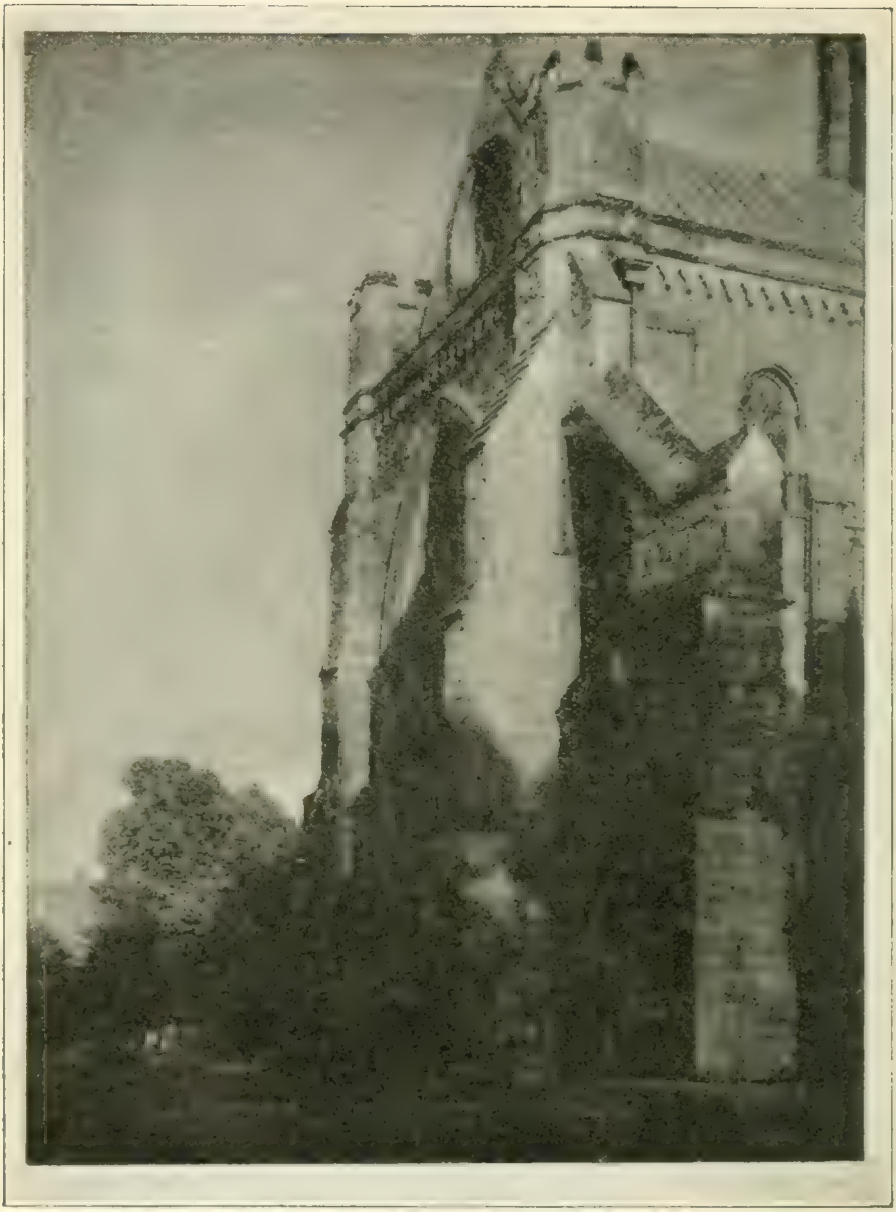
Miniature transcripts of works by Rembrandt, Vandyck, Claude, Vermeer, Reynolds and Turner referred to in the text pages.

Admiral Pulido Pareja
Velasquez

Inga Sontum
Clarence H. White

The Shadowed Stream
J. S. Cotman

The Slopes of Moel Siabod
Fred Judge



Chichester Cathedral
Thomas H. B. Scott
R.P.S. Exhibition, 1921

The Photo-Miniature
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What Pictorialism Is

There is always a deal of argument as to what constitutes pictorialism; and there always will be while it means different things to different people. To fly to the dictionary is not to get help on the matter; for a representation of a scene or an episode is not necessarily pictorial in the artist's meaning of the term, though it may legitimately be called a picture in the popular acceptance of the word.

The indefinable quality that gives charm to those works that we mount or frame or treasure in portfolios defies clear definition; but its power and presence is as certain a factor in it as breath is in living, and it is experienced about as unconsciously. The adept alone knows it when he meets it—others enjoy it unknowingly; and just as a child or a savage enjoys life without bothering about physiological facts, so the inexpert enjoys pictorialism in the graphic arts without bothering about the facts of aesthetics.

It is the picture-maker's obligation to produce in his work this elusive charm that will cause the plain man to acclaim it joyously, although neither knowing nor caring about the profound principles that are at the root of his likes and dislikes.

In so far as a photographer is a picture-maker

he also has this obligation imposed upon him. Does he fulfil it?

He can fulfil it if he will address himself to the task with singleness of purpose and in a docile spirit. He cannot if he believes that showy, daring ramp and swank will carry him through. Some sort of notoriety certainly he will get by this swash-bucklering—a nine days' wonder in an exhibition; but what is the real profit in that?

Neither can he fulfil the obligation by imagining that good technical photography can be made to yield the mystic charm. It does not, of itself. It never did yet. The photographic pictures we love do not owe their fascination to technical perfection; they owe it to this same old pictorial charm which has delighted us for centuries. There is not one art for the painters and another for photographers. There is but one art in the great sense.

Composition Formulae. Pictorialism has many aspects. In photography they lie chiefly in the direction of three things:—Composition; Chiaroscuro, or the designing of lights and darks; and that mysterious thing we call Quality because there is no name for it.

The first of these is the easiest to master, and photographers as a class compose well. It would be strange if they did not; for after the first short period of thoughtlessness, the results of which bring their own discontent, the tyro quickly pulls himself together, looks around, scans the work of others, and achieves enough of the faculty to save him from committing fresh indiscretions.

In the matter of choosing material for a picture, then, the camera man is not in need of much teaching. Perhaps that is why so many of his colleagues are anxious to teach him. It is a fact that the feeling of confidence one acquires, inevitably brings with it the wish to instruct. Hence the many many books on composition, the "chats" in our societies, the "notes" in our journals. It is

always composition. Nobody seems to have an idea that there is anything else to be learnt or taught pertinent to pictorialism.

The books on this well-discussed darling topic are loaded with wise saws and modern instances. We are told that pictures, to be fine, must be constructed on certain fundamental scaffoldings, which may take the form of pyramids, stars, L shapes, O shapes, S shapes—all the alphabet, in fact. And these naive wiles are offered as general principles. They are not of course. They are merely particular instances, each suggested by a particular picture. If one devoted a few years to such ingenious analysis of works of art, skeletons of this kind could be found on every hand, and the alphabet would be exhausted in quick time. The numerals would have to be pressed also, and eke the figures of Euclid. Composition is not to be taught this way, if it can be taught at all. The artist feels it as it grows on his canvas. He does not look up a pattern-book and say, "I'll try an H shape."

The great Jean de Reszke said that all there was to learn about voice-production could be written on half a sheet of note-paper. So it is with Composition. In nature it is ready-made, and its fitness or unfitness is merely the measure of our fastidiousness. Landscape harbours it thick and compact—we only have to pick out our bit. Portraiture produces it together with the sitter. It only becomes difficult when we want to be clever or "individual" and in such a mood reject the natural and the obvious.

Where Composition rises to the grandeur of imaginative design, embracing all the resources and inventions of masters like Michelangelo, Tintoretto, Veronese, and Titian, with their figures in the air, their architecture and drapery; then it is out of photography's scope. The camera-man has no business with the super-natural. His pictorial material is nature as the human eye sees it.

Design, for him, is therefore never more than the composition or *putting together* of actual things.

Composition is Relativity. There is the complete half sheet of note-paper secret; put things together. Do it—that's all. "How?" the doubter asks. Anyhow, so long as they *are* together. Don't worry! They'll make a shape of some sort! And what does it matter whether it is A shape or Z shape? The great sin in picture-making is *not* putting things together; that is, letting them be dotted about like the roses on a wall-paper. Things separated are things without a relationship; things near, touching, overlapping, have a most intimate relationship, and set up further relationships. They become interesting on this account. We like them, take notice of them. As I have said elsewhere; it is the difference between a lot of scattered links and a perfect chain. A chain is something with a purpose: links are but links! So if you lean your girl against the tree there is meaning in it; but if she is one side of the print and the tree the other, what is there in it but the uncomfortable feeling of antagonism?

Shapes and Lines. Thus it is obvious that Composition is very largely massing. But masses have shapes. A mass of old iron usually takes a conical shape; and—it is difficult to believe—this conical or "pyramid" shape is the one so often recommended in books of the past that deal with composition: a regulation more honoured in the breach than in the observance.

Shape in order to excite aesthetic emotions must have a little more life in it than this simplest of all geometrical figures. In the little transcripts from works of note, observe the variety and virility of pattern statements. You cannot deduce any generic shape from them, such as "star," "S" or "O". The painters of those things were not concerned with what later analysts could make of them; they simply let the shape come as it would,

but stopped and expunged if it was not handsome. That's all about scaffolds and underlying plans.

The same thing exactly applies to lines. They may come as they like so long as they are not antagonistic. Many lines can come together to express one idea; but opposition means rival camps, each with its own idea and pictorialism ought to avoid complexity. For example, two main curves sympathetically lying in the same direction give but one idea of direction, but if they oppose each other there are two ideas. (See fig. 2 on the page following, where I have grouped the four figures here referred to.)

Relationship, once more, is the only thing that really matters about lines, and even this is difficult to preserve always.

There seems to be an especial charm in the relationship of straight and curved lines. It is perhaps the idea of association of the rigid and the yielding that pleases. (See fig. 1.)

Veronese owes all the sound structure, the welding into a dignified strength of his elaborate compositions to the combination of straight lines in architecture with curved lines in figures. In portraiture the principle is of the utmost value, as the Vermeer and the Reynolds on the page of miniatures will show. The Turner will likewise show the gain to landscape of horizontals and verticals in buildings, as well as the beauty of radiating line systems.

Radiation. The very obvious relationship of radiating lines, especially when they are curved, hardly needs to be pointed out. In landscape perspective usually brings it about, as in the radiation of the furrows of a ploughed field, the edges of a road, railway lines, or the sky-line of rows of houses. Fig. 3 is a diagram of such radiating systems in the lines of hills, a river, a tree, and clouds.

The principle is also that of drapery folds. Suspend a towel by two points and see how the folds

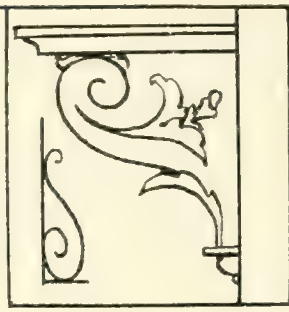


FIG. 1.

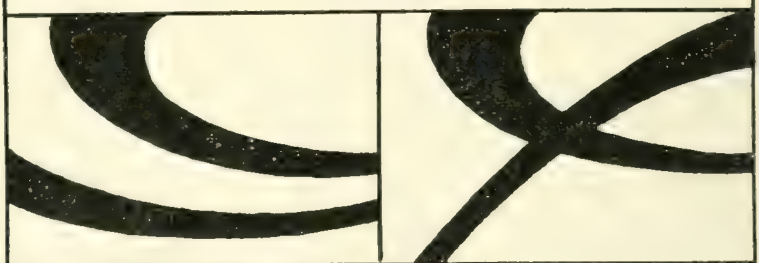


FIG. 2.

FIG. 3.

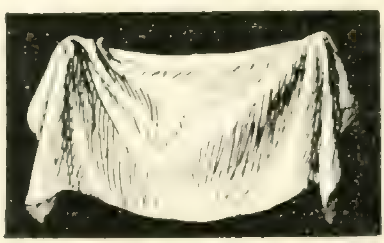


FIG. 4.

radiate from the points of support. (See fig. 4.) Similar points of origin exist in the costume of a sitter, the folds of which sweep away from the points in the most delightful systems; now short, now long, here firm, there broken. It is this curving radiation that is of such inestimable benefit in enforcing or mitigating, continuing or countering, the lines of the pose and the contours of the sitter. They hold the great resources of design in portraiture.

Chiaroscuro. Important as this matter of composition is, I doubt whether it is so vital a matter in photography as is chiaroscuro, or the interplay of light and dark tones; and it is to this section, therefore, that most of my space is devoted. These tone alternations can make or mar, respectively, a poor or a fine composition. The most engaging system of lines is powerless to exert its charm if the tone modulations veil and transform it.

The truth of this was brought home to me in preparing the little sketches from the old masters. I first intended to make real diagrams, but having started with the Tintoretto I awoke to the fact that, for photographers at any rate, composition was more a matter of tone than of line; and after the Titian had got me at its mercy, it was the tone that fascinated me throughout the rest of the job. The ordinary splash-and-blob sketch would have no doubt elucidated certain principles, but it would not have shown how naturalism and realism—common factors both in photography and painting of the best epochs—should be preserved in spite of all noble desires to make fine tonal schemes.

The various bits of naturalism and realism (observe I do not say literalism, and students of my Course will know why) are the artist's mosaic-blocks with which he builds up his picture. They may take the form of figures, heads, robes, animals, stones, trees,—anything; but they are selected so that their tone and colour may build up the beauty

of the picture. Therefore, though separately they appeal to the intellect, in concert they function for beauty, which is a matter of the senses, not of the intellect.

This working with items intellectual in order to produce a complete fabric of beauty which is sensuous, is a difficult task enough in painting, but more difficult still in photography; because there, the building-up process is not creative, it is only selective. But this is exactly the reason why the results of the painter are such valuable lessons to the photographer, who, when he has studied paintings to the point of enthusiastic admiration—which he too seldom does—is not likely to let anything finely pictorial slip by him when he finds it in nature. True, it is rarely that he will come across nine nude gentlewomen disporting themselves on clouds, but he will see Tintoretto's idea in the "Nine Muses" in many things that occasionally pattern themselves against the sky. The glory, if not the literal detail, of portraiture and landscape he will find exists in tone-massing—that is, so long as the dark tone does not debase and smother form, or the light tone brighten it away to nothing. I hope the meaning of this reservation is well apprehended.

The examples show no case where an important feature or incident has been sacrificed to a scheme of chiaroscuro. But in photography of the "superior" kind this is, alas, not an uncommon fault, and a perennial stumbling-block in the path of public appreciation. Although the great portraitists were indifferent about losing the feet, or garments, even hands, in a simple spread of tone, they jealously preserved the clarity of the face; witness the Vandyck, the Vermeer, and the Reynolds. I can recall some camera portraits where the culmination of light is on a nondescript object out of the range of focus in the background. This is sacrificing the intellectual to the sensuous.

In painted landscapes of the past, literary inci-

dents were made use of in the same way. A group of figures not only adds human and episodic interest, but is coerced into supplying small bright and dark accents for a foreground, which is thus kept in its proper plane without competing against the true motive of the picture. In the case of Claude, Corot, and other romantic landscapists, this motive was invariably the sky and the light it shed over the distance.

Tone Designing. The smallness of scale of my little transcripts permits them to be seen in a generalised manner; for what detail there is will only yield deliberate scrutiny, and yet *nuance* of tone is evident enough. The originals are from paintings, with the exception of Turner's "Liber" print, "Bridge and Goats." The Liber Studiorum series is a gold-mine for students. An instance of every principle so far alluded to, and many more, can be found in this "Bridge and Goats" if it is studied. For photographers, the best lessons from paintings are in monochrome interpretation. These of mine are, I admit, on the bright side. I have used a full scale, because, to my view, the full scale usually holds the most beauty in monochrome. Perhaps the short scale is an invention of the Devil in bromides: engravers and etchers have never favoured it, and I think never will. The conventional browns and blues are likewise a departure from a good tradition of black. The lower limits of these tints are soon reached, and moreover lose quality before the last is reached. If we are using tone for beauty, why debar ourselves from its full resources?

The transcripts show that the massing of tones into definite shapes was one of the chief things that exercised the ingenuity of the great ones in art; but it is just as obvious that this massing was never arbitrary. The naturalism of light and shade was the bed-rock of the most successful schemes.

Another fact that emerges is that the masses

of tone, though self-contained, were never flat detached patches: there was always a passage of transition; a delightful melting and merging, sometimes gentle and protracted, sometimes "steep" and rapid. Of such resources Rembrandt was, of course, the great exemplar. Abraham entertaining his angels is a good instance. Rubens loved opulence and sparkle within the masses. He always worked for richness, and therefore his pictures are less characterised by simplicity than by complexity; but it is always the complexity of magnificence. As a designer Veronese is perhaps finer because although his schemes are opulent also, they have a simpler statement of chiaroscuro. In both respects Titian takes the wise and happy mean without losing impressiveness.

The Dutch are popularly supposed to be slaves to detail. I always see in the best of them a marvellousness reticence and breadth, and a union of intellectual and sensuous factors. Could the Vermeer be more ingeniously contrived? How perfectly logical is the relief of the head by the dark map, yet how valuable is that square mass with its vertical and horizontal lines! As to detail for its own sake, it is a curious fact that the Dutch painters who were the most meticulously microscopic were at the same time the broadest in effect; for example, Van der Heyden and Berck-Heyde.

Some may think that the camera-picture could easily achieve as much as these transcripts hint at. I think it should; but I have seldom, if ever, found a photograph that came very near to the old pictures on these grounds: certainly not the "perfect negative" production printed by "straight" methods. The American variety of this much prized production always appears to me to want putting in some kind of oven that would just melt its virtues into the charming peccadillos that we all sympathise with. The tones would run into each other here and there without loss of real

differentiation, and all the tooth would be melted off the detail. We should then have what the painter always tries for in his management of edges—just that coming short of actual precision which makes human vision comfortable and proof against fatigue.

These matters are intensely difficult to discuss, and one can easily give a wrong impression. For to begin with we ask for simplicity and breadth, both massing and a few tones; and next we stipulate for *nuance* and transition of some parts into others. We want no bristling detail, yet we cannot put up with flatness in passages that are illuminated. Neither edgings not "fuzziness" will suit, but firmness of contour and appreciable accent are imperative.

The Quest of Breadth. It is when we come to Tone in photographs that the real trouble begins. A tone scheme in nature that is pictorial, broad, fascinating, is only so by virtue of the eye that sees it so. The unresponsive eye does not see it so. There is doubtless ample detail of light and dark *littleness* on the retina in every case; but the mind of the artist edits his retina report and expunges all littlenesses. It is this way of seeing which results in the breadth that characterises all great works of the past and will do so in those of the future. It is a result which *un*pictorial photographers either do not know or do not trouble about; but it is eagerly sought by the pictorialist of the more enlightened kind; yet he, poor soul, cannot get it in his prints without recourse to practices that have brought him into hot water, not only from the champions of photographic quality, but from the painters themselves, some of whom have caused messages to be sent to recommend that "faking" should be discontinued. Did they know what they were talking about; and were they to blame if they did not?

Painters' Resentments. We must remember

that the painter lives in a different world. He cannot be expected to know from day to day what goes on in the photographic world; and when his opinion is asked about photographs he naturally gives the one founded on common hearsay and tradition.

But we are bound to admit that tradition is a legitimate factor in thought and opinion. It has its roots in general truth. Pictorial photographers know well enough what the traditional judgment of photography has been. If they did not know, they would not have formed their Societies with the express purpose of giving to the pictures they make with the camera the best artistic significance possible in order to undermine this tradition which misrepresents them.

Admitting, then, that the painters do not know what is being done for the advancement of camera art unless we get them to our exhibitions and surprise them, it is easy to understand their attitude to the average good photograph. They say, "Wonderful!—the hand could not do this," which does not mean that they wish the hand could. In company with all mankind, they think the photograph wonderful; and being, as artists, responsive and expressional beyond the ordinary, they see the wonder more keenly, and give it more emphatic praise than does the "plain man."

Now comes your "faker," and, in a legitimate desire to lift his work out of this plane of mere wonder, for which he feels he is not personally responsible, and which, by its universality, has grown a little stale, he robs his print of the very characteristics that are its chief claim to wonderment.

This the painter will not have. "No," he says, "what I saw first is something I could not have done myself. This that you show me now I could have done much better myself for you've got it all wrong."

The conditions for breaking down the evil tra-

dition attaching to camera art are well nigh unattainable because we have always with us the probationer working by trial and error, whose results *do* manage to get into public exhibitions and into journals where they meet the public eye. They get there by reason of the slack artistic standard prevalent in these activities.

The man with art ambition may be sure of the painter's extended hand when his work is such as will not give offence to knowledge. For the painter *knows*. Whatever he paints, whether it be lofty allegories or cheap and popular anecdote, he *knows;* and he repudiates pictures that are full of errors and solecisms, the result of immature observation, or the coming at some startling effect by cutting the Gordian knot, and outraging naturalism, in the belief that the violation will not be noticed. *This* is what the painter resents—not control as control. He of all workers is the one who believes in alteration; but *he* knows what to alter to. It is this saddling of an accurate medium for truth-telling with the mistakes of ignorance that has caused what feud there is between painter and photographer.

Admitting that alteration is more difficult, if not impossible, in photography than in the graphic arts, it behooves the camera artist to feel the sureness of his steps before he takes them. He must learn. He has more need to learn even than the painter, because he has his intractable medium to manage. His picture is given him ready-made by the lens. Rarely does it hold that indefinable fascination that a work from a graphic artist's hand holds, be it painting, drawing or etching.

Photographic Shortcomings. At a meeting of the Royal Photographic Society, Mr. J. W. Lumb, a gentleman of much critical acumen, once remarked that "the work of the pictorial photographer did not show the same spaciousness of design, the same largeness of conception, as did that of the painter or etcher." Mr. Lumb here hit

upon the main shortcoming of photographic interpretation, known and felt by artistic photographers generally, who endeavour by all means in their power to repair the omission. But what are those means? They are certainly not those of "perfect" photography, from which the lack arises. The perfections of photography as a recording medium stand more and more in the way. This is why we pine with Mr. Lumb for spaciousness of design and largeness of conception. This is why we finally break away from "straight" photography.

There is a mighty feud between those who attempt to make pictures by the perfections of the superhuman vision of the modern lens, and those who attempt the same by the approximations of their response to what their own eyes can see; for the latter discern in the painter's and draughtsman's work a quality of suggestion that seems more and more impossible to the highly perfected photograph.

Science and Art. The triumphal progress of photography is in the direction of science. In every branch of scientific research the camera takes day by day a more important place. Its exactness, its delicacy, its scrupulous and highly sensitive power of recording the infinitely big and the infinitely little, leaves us all lost in marvel. But all these glories are dependent upon the automatic operation of activities in which man himself cannot intrude. The sensitiveness of man's organs of sight and touch have long since been surpassed. The human eye, in comparison, is a clumsy, primitive, falsifying organ that is still doddering at what were once the very initial stages of research. Science has handed photography over to delicate instruments and complex mathematics, eyes and fingers being no longer efficient enough.

The great gulf between science and art has widened, and is still widening. Art, however, remains primitive, for it is elemental. Centuries and mil-

lenniums make no difference to it. But science is a growth, it flourishes by the facts it feeds on.

For this reason the whole business of pictorialism from first to last is on a different footing and in a different atmosphere from photography of exhaustive record.

The artist does not say "How much can I show; what subtleties can I reveal?" He says "How *little* can I show; how can I sufficiently generalise and simplify in order that the inner spirit shall find expression, freed from the complications and reactions that cloud, confuse, distract and dissipate in the picture?"

Beauty enters by the eye, it is not revealed by the sensitometer. The human eye's limitations are still broad enough to embrace all that the human mind asks for from the appearance of things in nature.

Here we get the eternal and irrevocable feud between science and art-fact and feeling.

Photographic Perfectibility. In the camera-pictures of our best technicians we find the results of photographic perfectibility. The eloquent breadth of shade, dear to art, is sullied and confused by a thousand spots of varying lighter tones, seen only by the lens. The broad and generous fields of light which delight the eye are muddled up by innumerable patches and spots of darker tone. Thus both lights and darks lose their distinctive characteristics and approximate to a middle condition. Consequently the modern camera picture of the technically perfect kind is truly both *monoton*ous and monotonous.

That astute and sound critic P. G. Hamerton has said, "If, in a picture anyone is represented as holding written or printed matter in his hand, and the letters are made out carefully, you may always be certain that the art of the painter, however manually skilful, is mentally immature." . . . "The true advance of graphic art is towards a summary and comprehensive expression, in

which detail is made use of only just so far as is necessary for character or for the degree of explicitness required by the subject as a whole. The mature artist is not blind to the infinite detail of nature, but his art is not an imitation of it."

These are truths, the very opposites of which obtain in modern photography. A distant tower in a landscape is, to our dear old imperfect eyes, an object of glowing light or significant dark, according to its relation to its environment. In either case it is lovely to look upon. Through the telescope it rushes towards us, an object of charted stones and mortar-joints, of cribbled surface and discoloration of decay, of lichen spots and a million little cast-shadows. Its joyful vesture of broad light, or its portentious veil of simple tone has vanished. The cheeks of a fair young girl is to the eye that delights in it smooth, clear, equable in tone, and of exquisite fineness of texture. Art accepts these conditions as those of beauty. Under the microscope it is a tract of pitholes and fissures with an oily glisten; with craters exuding effete matter amongst coarse upstanding hairs. This is the ideal of scientific vision—eminently serviceable to the pathologist.

The telescope and the microscope and the X-ray are the goal towards which modern photographic registration is being hurried. It is all stupendously splendid in science, but it is beyond the occasion of pictorialism. It misses so much.

Beauty by Defects. When I see the work of the old pioneers of photography I discern that the statements are simple, broad, clear. They are statements in the terms which painters have used always and always will. They are the statements that catch at the heart. They are almost solemn in their grand simplicity. And while I admire this pictorial eloquence I remember that the medium was in its infancy. Enterprise had not yet laid hold upon it to make it fool-proof for the million. But today even the pictorialist will aver

that the best negative is necessary for the best result. This begs the question of which *is* the best negative. To my mind, it would be that which gave only what was wanted; and the worst would be that which held an embarrassment of riches in things which did not serve the purpose in hand. Am I wrong then in assuming that for pictorial purposes the earlier negative—the paper negative of D. O. Hill, and of Dr. White of the same era—is perchance more likely to come nearest to the postulated "best negative" than is the latest production of emulsion acted on by the latest miracle of lens-making?

To have that technical shibboleth "correct exposure" called to mind in looking at what is submitted as a picture is damning, because it is foreign to the proper mood of *transport* which a picture should invoke. You cannot be *carried away,* for that is what transport means, when you are held back by such absolutely technical considerations, particularly when the "correctness" of the matter accords solely with the superhuman standard of the technician.

The poor photographer cannot escape this doom; but he need not revel in it. He need not make his exposure the *pièce de résistance* of his work, and expect art critics to praise it because he has made it show what should not appear.

I surrender to no man in my capacity of admiration of the straight print. And I can admire it because I do not confuse it in my mind with an attempt to give artistic expression to a pictorial idea. I keep the picture distinct from the view.

That a scientifically perfect photograph untouched, uncontrolled, *does* at times give a glorious pictorial idea is a fact I readily admit and rejoice in; adding only that the occasions on which this occurs in a generation can easily be counted on the fingers and toes.

This perfectibility of the photographic or scientific result is a matter of technical care and

dexterity. Could all attain the same technical knowledge and dexterity there would be a tiresome absence of variety. One photographer differs from another only in his falling short of this perfectibility.

A Warning. Here I must interpolate a little warning to safeguard myself from misunderstanding. In all these arguments I am assuming that my readers are advanced in their craft. The elements of technicality are taken for granted; composition is taken for granted. My remarks would not be salutary for beginners; they apply only to those who are practised picture-makers, and they oppose one executive method to another, that is all. So with the question of exposure. It is understood that gross under- or over-exposure is hopeless from any point of view. I am only asserting that the meticulous niceties are more likely to be a hindrance than a help to the man who seeks pictorial charm above anything else.

Over-Subtlety. Apart from the admitted dullness and sleepiness of the average bromide enlargement, the outstanding faults in pictorial photography generally, are feebleness, want of sparkle, monotony, and tonal flatness. These faults are often directly caused by the over-subtlety upon which I have remarked. As a monochrome method photography approaches most nearly to the etching, and like good etching it should, when practised for pictorial purposes, generalize its tones. Four or five grades of tone are ample: and therefore the fifty that we constantly find — and too often in the wrong places — are ten times too many.

A sparsity of tones does not affect gradation. It affects *graduation* of course, for that goes by steps or degrees. But gradation has no single tones; it is a liquefaction, and it matters not how few or how many tones are liquefied.

In good etchings it will be seen that all the strength, relief and sparkle they possess is due to

the fewness of their separate tones and the absence of detail in the shadows, where the eye sees none. In the illuminated parts the small incidents of form are completely enough given; but even then they are kept bright with clear lights. The cameraman with a photographic conscience is as frightened of showing high lights without detail as of showing shadows without detail. He crowds in all he can and crowds out the breadth which is the simple statement that this thing receives light and that thing does not. Such statements are in the language of art; the inventory of details of texture is in the language of science. The terms "under-exposure" and "over-exposure" postulate a mean, or standard, which does not exist outside the meters sold by the dealers, and then it signifies the utmost the lens will register. This is not a human standard. It is not a standard serviceable to art.

The Velasquez Method. The faults of the scientist are the resources of the artist, who owes his increase of clear area and extension of scale at the extremities of tone to what the scientific photographer would stigmatize as under- and over-exposure. This I have elsewhere called the Velasquez method. That painter, more than all others, and at a time when the Italians and Netherlanders were working in the old traditions, saw the great and poetic significance of the lit and the unlit. He could, had he chosen, and as he did earlier in his career, have seen much more in the legs of the Admiral Pulido Pareja; but he prevented himself from seeing more. By auto-suggestion, which is at the back of all artistic vision, he told himself that there was no more to see, and that the breadth—emptiness if you will—was a delight in itself, for it caught that unconcentrated view of things that was new to the consciousness of his day, but truth notwithstanding. Fortunately he had no camera to disabuse him of this fine and simple conception of the salient aspects of

form, with all its strength, repose, and dignity.

If Velasquez had lit his sitters brilliantly he would doubtless have painted all that the light revealed. His method was as much one of lighting as of interpretation; and its merit was that he did not, by concentrated scrutiny, read into his shadows what his normal vision did not easily find. There are other methods of lighting, of course, and some may be more gratifying to colourists; but to the monochromist Velasquez is a supreme exemplar. He is so to the etcher, who knows that form, outline, pattern, the dark and the light must be free from complexity. He and the etchers should be exemplars to the photographer who aims at picture-making.

A glance at Clarence H. White's picture "Inga Sontum" reveals the fact that the Velasquez vision is by no means dead. Mr. White, no more than the Spaniard wished to give an inventory of the shadowed parts, which by both were used for what they gave of structure in design and simplicity of tone. Conceive the lady's dress and the curtains all lit up by reflections and *longueurs* of exposure, and it will be evident that the work's particular charm would give place to something else.

Out of doors, when one can photograph at all, there is usually less blackness, but not less mystery. Because our vision takes in more, the large areas reduce down and differentiate, with an occasional accent of gentle light. Yet the prominent idea is an all-embracing shadow. I think Mr. T. H. B. Scott renders this beautifully in his "Chichester Cathedral," where the shadows retire while the turrets and buttresses assert themselves modestly, yet with strong beauty-claims, in the ambient air lit by the setting sun. Here chiaroscuro is served by perfect naturalism.

Mr. Fred Judge has achieved the same thing with colour interpretation. There is no broad light and shade in "The Slopes of Moel Siabod";

it is a broad daylight scene with blue sky and rosy-white cloud behind a deep tinted mountain veiled by a haze. Yet again the greatness of the picture lies in the beauty of the simple tones, so boldly separated in the scale. It is the mountain and the cloud that give the message. Much of the print's poetic quality is doubtless due to its being a transfer.

The Promise of Transfer. To my mind, the brightest hope for pictorial camera work lies in the pigmented and transferred print. When we get as a general thing the true and sympathetic tone-values as seen by the poor old maligned human eye, with the brightness and breadth that these tone-values secure; and when we have these results feelingly and cleverly transferred to a non-photographic basis, so that only paper and paint make up the material, then we shall begin to see what pictorialism means. Then we shall surprise the painters to some purpose, and shall be able to kill that grudging spirit abroad that meets our best efforts with "Oh, it's only a photograph." This is what all camerists have had the hope, uttered or unexpressed of doing. This hope it is that has led them to adopt the fatuous resources and subterfuges of "vignetting," of "sketch" portraits, and has given rise to gum-bichromate, oil, and bromoil methods, and every other device that spells a hidden scorn of the ordinary thing. And this brings me to another important section of my subject.

The Creative Ambition. What do these resources portend? Do they not signify a desire to get upon the footing of the creative artist? We cannot burk the fact that the complete and finished image which arrives in a flash is something of an aggression to the man who wants to feel and exercise his power. He is always rather ashamed of having to say: "Alone I did *not* do it." These several resources do, in fact, give him the opportunity of using his knowledge, judgment

and skill, and of giving a touch of individuality to the final result. Their great popularity is accounted for in no other way. But all this is only to be interpreted as a feud between the aspiring photographer himself and the automatic and scientific processes of his work — a feud which has most distinctly extended to and become associated with the advocates and workers of pure photography; so that now we have the very lively opposing Greek and Trojan camps of "Fakers" and "Straightists." To my mind, this is a more inevitable feud than that between painter and photographer generally; and I can easier imagine a truce between the fakers and the painters than between the aforementioned Greeks and Trojans.

But to bring about this reconciliation with the painters the fakers must thoroughly justify themselves in a procedure which is, in its nature, illogical and subversive. Will they be able to do so? I will try to show why I think the faking procedure illogical and subversive, though I do not deny its legitimacy.

Painter and Photographer. All the *painter's* processes start at a single point. He draws. Draughtsmanship is a temporal as well as a spatial art. It begins at a particular moment and finishes at any other moment in the artist's lifetime. It likewise begins necessarily at one particular spot of the picture and progresses in space over the paper or canvas. This is the meaning of the word "drawing." The pencil or brush is *drawn* or dragged, and leaves a track which is a constituent of the work of art.

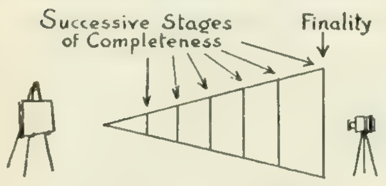
Here is the first and *fundamental* difference between painting and photography. In the latter there is *no* such drawing. The temporal is absent, the spatial only remains. Light, with its onslaught, does not commence at a point and proceed all over the sensitive plate; it crashes against the whole area of it, at *every* point, important and unimportant, essential and unessential

alike. The counterpart of the preliminary sketch does not exist, nor does that first outline or smear of tone which to the arist is the pointed end of a pictorial cone. This cone he builds up by slow degrees as far as he wishes. Sometimes he has no wish to go further than his first outline, or "rub in" which his mind clothes with all that would appear in a finished picture.

If he goes to a next stage, carrying his outlines further, and perchance washing over it a few flat tones, he is doing what Claude did in his "Liber Veritatis" — the pen and wash drawings treasured in the Print Room of the British Museum. Turner, in his "Liber Studiorum," went one stage further than this in putting his designs on copper plates, adding tone and finish as he pulled proofs of them. Every added touch carries the beginning one step further, not only in form, but in content, so that each stage of the work has its own worth as an entity. The picture by Cotman given here, is such a stage, with its result quite satisfying to the imagination. The increase in work and in content at each stage results in what I have likened to a pictorial cone.

Here we have the painter at one end and the photographer at the other, for the poor photographer gets the "base" of the cone at once. The point to note is that at any of these early stages the work may, on its merits, be considered as a complete work of art. Its beauty consists in its suggestiveness. To Turner himself, and many others doubtless, this freedom from a final completeness admitted such joys to a sensitive imagination, that it was often much more delightful to keep the works in this so-called unfinished state than to limit their dream capacity by pushing them to

THE PICTORIAL CONE



definiteness of form which would be the *ne plus ultra* of a fixed content.

But the poor photographer at the other end of this felicitous progression has no chance of thus training the picture in the way it should go, or of arresting its growth at any particular stage. If he wishes to give some semblance of satisfaction to such desires, he has to try to work backwards. Starting at the broad end of the cone with the most uncompromising super-human finish and completeness, he must perforce try to cut his way through this luxuriant tangle of finality, and get at something farther back, something more elastic, more spiritual, nebulous, pregnant, promising.

But it is as futile as trying to turn an old man into a promising youth; and, as I say, illogical and subversive. Science which confronts him, frowns at such a "Through-the-Looking-Glass" procedure, and Art, in the distance, laughs. "Fuzzygraphs," vignettes, "Sketch-portraits" and such ruses may simulate the earlier stages of the organic growth of a painter's work, wherein imagination plays so freely; but they cannot actually become such. And this *non possumus* is the fate, irrevocable and bitter, that awaits all who would work by the method of the painter with the apparatus of the photographer.

This is really the greatest feud—the feud of the processes. Can it be dissolved? It can, as I think, by concentrating upon art rather than upon science; by looking for those aspects that art perceives and leaving those that science brings to those who can profitably use them; by remembering that the lenses and the emulsions of early days were *less* sensitive than those of today, and yet gave artistic results. Above all, I would say: Let us be *truly* artistic, and that by habit, not by spurts. Let the mind be trained in beauty-sensitiveness, which puts virtuosity in its right place. We must not become "arty"; for artiness in manner, in the home, or in costume is mere "window-

dressing." The commonplace life, with its drudgery, and even with its squalor, has produced, on the whole, more great art than has the environment of princes.

Seeing Largely. The great thing needful is a constant eye on nature. Innumerable walks, *alone,* with the eyes open, in all weathers. This will give the power of a keen seizure of essentials, and a perfect understanding of the shorthand of those other observants—the great artists—in whose work are found confessions of feeling that escape detection by all except those who likewise have felt.

To be a pupil in Nature's hands and to seek the guidance of those who also have been her pupils—the sincere and inspired painters—is to become healthy and masculine in one's work.

The photographer must take off his spectacles, drop his magnifying glasses, and look up and out; get the large vision.

There is not one in a hundred who can see with the large vision. They think they do, but they don't. It is really a trick of the mind, which seems to put a sieve or a filter before the retina, and so allows only the big aspects to pass for registration. A man who has the power can make this adjustment in an instant. At one moment he may be looking on a scene as a detective or a sentry might look upon it; and then, with a kind of a click, he can see it in the large way, when quite a different set of phenomena come into registration. This is a mental, not a physical matter, and is impossible to explain, but an easy thing to be acquired by first learning it in fine works of art, and then seeing it for one's self before a scene or a sitter.

If the earnest photograhers who want to make fine pictures would try this training of mind and eye there would be an end of the flat, soppy print that has neither grit, accent, firmness of line, nor breadth of tone. We should then be delighted

with the clean and firm statements, and the bright lights and sharp shades in tonic contrast, such as the etchers give.

Let us think more that art is flint and steel and wine, and give cotton wool and milk-pap a rest. There will yet be room enough for all the subtlety we are capable of, for our tone values must be subtly adjusted, not made to pass muster by being softened, muzzed and otherwise evaded. And it requires more subtlety and sensitiveness to simplify into a few broad tones than to take the unwinnowed grain, chaff and all, that the photography of today supplies wholesale. When all this comes about, the painters will be the first to approach and say "This is fine" — and the feud with them will be finished.

There is also the incontrovertible fact that pictorial photography is, after all, a hobby only— not a profession, as painting is. This means that its devotees are, in the mass, not artists by long technical training of hand and eye, and do not live in the favourable environment that belongs to the atelier. They have not, to use a colloquialism, "sucked art in their pap," however amenable to its influences they may be by temperament. To the outstanding few alone is due the gratifying acclaim which the occasional painter is now and then surprised into at sight of a camera picture.

We must not be astonished if the painter, who knows only two well what his knowledge and skill has cost him, and how long it has taken him to acquire his power, resents, as we are told he does, any departure from the mechanical wonderment of a scientific process, in the direction of his own preserves of handwork, wherein nothing whatever is done except by the impulse of this knowledge and feeling upon which he puts the highest value of all.

Technical Bias. Mr. T. H. B. Scott, whose oil-print, "Chichester Cathedral" is reproduced here,

said in a recent lecture at the Royal Photographic Society: "There was too little in our pictorial work as shown, and particularly as illustrated in the photographic press, that made an appeal for its own pictorial merit rather than for its photographic claims." Again: "Photographic bias rather than pictorial discrimination seemed also to influence the judges and selection committees, and many pictures received more than their due recognition on account of some difficult photographic performance more or les skilfully executed, rather than because of their truth of vision. Photographic jugglery was often their only merit, and was so assertive that pictorial truth or the lack of it seemed to command but little consideration."

In the discussion which followed, the redoubtable Mr. Lumb said: "With regard to the lecturer's statement that they were too apt to allow judgment to be swayed by photographic quality rather than by pictorial merit, he was in hearty agreement. We allowed ourselves to be influenced by technique rather than by temperament, by the work of the craftsman rather than the achievement of the artist, by work that smelled of the dark-room rather than which breathed of the open air."

Art's Laws. These remarks exhibit the tendency of the pictorial spirit in photography. They reveal its inevitable and laudable ambition. In America, far more than in the British Isles, a bold spirit of revolt against technical standards and judgments has long been abroad. Perchance, the liberty gained has sometimes led to licence. That is regrettable, because true art is no more to be confounded with licence than with pedantic restriction. Art obeys laws as inexorable as those of science, only they are felt within, not learnt without. They are unwritten laws ordained by feeling and response to beauty. Those who have obeyed them most sedulously and faithfully throughout the ages, are the greatest in the

world's esteem. Photography cannot change, add to, nor detract from these laws. Camera art is the same old art that the giants of antiquity discovered; that the artists of the middle ages knew; that the poets and painters of the renaissance cultivated, and that each in various ways brought to perfection. To think that a photographic picture must be artistically different from any other kind of picture is childish. In its essentials, its principles, it must be beautiful or it is nothing at all, pictorially. If it is beautful, it is so by reason of principles that are independent of both subject-matter and of medium: the everlasting principles, in fact.

A few of these eternal pictorial principles, as I have attempted to show, are opposed, neutralised, countered, overthrown by the insistence in scientific photography of certain other principles—admirable enough in their proper place—which by their ubiquity and constancy shackle freedom of choice in the matter of allegiance to those unwritten laws the recognition of which constitutes the supreme artistic power.

F. C. Tilney.

BOOKS

The best possible supplementary study for the reader whose interest has been quickened by this plainly helpful statement of "What Pictorialism Is," would be the six lessons and test papers which make up the course on **"The Appreciation of the Fine Arts,"** prepared by Mr. Tilney and announced elsewhere in this issue of The Photo-Miniature. This Course has been enthusiastically taken up by many individual and collective groups of pictorialists in England, and is really the simplest and most practical way available for obtaining that special training in pictorial photography which so many photographers desire.

The two issues of Mr. Tilney's "Tracts for Pictorial Photographers" thus far published: No. 1, **"The Real Pictorialism"** and No. 2, **"Oil, Bromoil and Transfer,"** in which latter Mr. Fred Judge gives his working methods and formulas for these processes, will be found most helpful. They, also, are announced in this issue.

Of books dealing with pictorial photography, the following are recommended as giving practical instruction in the technical side of this sort of work.

Pictorial Landscape Photography, by the Photo Pictorialists of Buffalo; with chapters on Multiple Gum and Gum-Bromide Printing. 236 pages, with 53 illustrations by members of the Society. $4.00.

The Principles of Pictorial Photography, by John Wallace Gillies, 253 pages, with 76 illustrations by well-known pictorialists. $3.50.

Pictorial Photography, by Paul L. Anderson, which gives the author's methods of working the platinum, carbon, gum, gum-platinum, oil and bromoil and photogravure processes. 302 pages, illustrated. $3.15.

THE PHOTO-MINIATURE Series: No. 188, **The Exhibition Print,** by Ben. F. Lubscher, illustrated, 40 cents; No. 186, **Bromoil Prints and Bromoil Transfers,** illustrated, 40 cents; and No. 185, **Kallitype and Allied Processes.**

News and Comment

Alfred Stieglitz. The Royal Photographic Society of Great Britain has awarded its Progress Medal—the Blue Ribbon of the photographic world—to Alfred Stieglitz: "for services rendered in the founding and fostering of pictorial photography in America, and particularly for his initiation and publication of 'Camera Work,' the most artistic record of photography ever attempted."

This wise and generous recognition of the unique value of the life work of Alfred Stieglitz will, I hope, give as much satisfaction to Stieglitz himself as it gives pleasure to those of us who have watched the development of his work during the past twenty-five years. No other man among us has devoted so much unselfish labor and self-sacrifice as Stieglitz has given to the advancement of photography in America. No other photographic publication has attempted to present the pictorial possibilities of photography as splendidly as "Camera Work." Perhaps the award of this much coveted distinction by a foreign society will awaken a keener appreciation of the man and his work among his countrymen.

The Photographers' Association of America will hold its convention this year at Milwaukee, August 4 to 9. Secretary S. R. Campbell announces the opening of a cooperative campaign to double the membership (at present around 1200), which can easily be accomplished if each member will pledge himself to obtain at least one new member during the year. The many practical advantages offered by membership in this national organization should win the active support of all

who follow photography as a profession. Among these advantages is the Winona School of Photography maintained by the Association, which offers a course of practical instruction in studio work under the direction of a portraitist of repute for the nominal fee of fifty dollars. The 1924 session of the School will open July 7. Application for enrollment should be made now to the Secretary of the P. A. of A. Bond Building, Washington, D. C.

Kodak is in the dictionaries as an everyday word, but this does not seem to prevent the curious from continual enquiry as to its origin. I am officially informed that the word Kodak was coined by George Eastman, for use as a trademark, prior to 1888. It is a purely arbitrary combination of letters of the alphabet with consonant and vowel sounds; meaningless as a child's first "goo," terse, abrupt to the point of rudeness and snaps like a camera shutter.

Courses of Instruction in Photography are being given, under the auspices of the Department of Photography, at the Brooklyn Institute of Arts and Sciences. Miss Sophie L. Lauffer is teaching Pictorial Photography for Advanced Workers, with especial reference to portraiture, and William H. Zerbe is teaching The Rudiments of Photography. Mr. Zerbe is also giving a series of practical demonstrations of various printing processes, copying, enlarging, combination printing and composition. The fees for these courses are extremely moderate.

Exhibitions. The Third Exhibition of Photography by Alfred Stieglitz is announced, to be held at the Anderson Galleries, New York, March 3

to 16. Less than a hundred prints are to be shown under the general caption: "Songs of the Sky" (1923), with a few portraits and half a dozen early prints dating back to 1899.—The Museum of Fine Arts, Boston, has recently added to its print collection 27 photographs by Mr. Stieglitz, and the R.P.S. (London) has secured a complete set of "Camera Work" for its Library.—The International Exhibition held at Stockholm during January, says Dr. H. B. Goodwin, was an unparalleled success. The total number of exhibits was over 2000, of which about 1300 were hung in the pictorial section, representing the best work done in this field from the early days of Mrs. Cameron down to the present time. America was well represented by the work of Pirie MacDonald, Clarence H. White, Louis Fleckenstein, Arthur F. Kales, R. Dooner and Frank Eugene.—The beautiful little city of Wanganui, New Zealand, has acquired by bequest a magnificent art gallery, equal in architectural splendor and acreage to the art galleries of, say, Rochester or Detroit. It has been decided to devote one of the bays in this gallery to a permanent exhibition of pictorial photography. Mr. Frank J. Denton, the leading photographer of Wanganui, has undertaken to obtain gifts of prints for this exhibition, and asks that American pictorialists willing to cooperate should send a representative example of their work, addressed either to him or to the Town Clerk, Sarjeant Gallery, Wanganui, New Zealand, marking the package for Customs purposes: "Photographs for Exhibition only." I hope that American workers will see to it that American pictorial photography is properly represented.—The One-Man Exhibitions at the Camera Club of New York continue to attract keenly interested crowds. The January exhibition comprised a display of prints in bromoil and resinopigmentipia (an Italian concoction) by Joseph Petrocelli. The February show was a colorful exhibition of

multiple gumbichromate prints by John H. Garo, of Boston.—The Photographic Section of the Portland, Maine, Society of Art held its annual exhibition in January.—The Pittsburgh Salon of 1924 will open its doors March 1 and continue during the month; as also will the Fifth Buffalo Salon, at the Albright Art Galleries in that City.—The Ninth Annual International Salon of Pictorial Photography, under the auspices of L'Association Belge de Photographie, will be held at Brussels from April 12 to 27.—And the Royal Photographic Society, London, announces its sixty-ninth annual exhibition as to be held in the House of the Society from September 15 to October 25, 1924.

The Kern "Bijou" Camera is the first of the new season's hand cameras sent to me for review. Made by the well known optical and survey instrument firm of Kern & Co., of Aarau, Switzerland, it is, I think, the first camera of Swiss manufacture to be introduced here. It is a plate camera, for pictures 2½ x 3½ in., built of solid aluminum with rounded corners with a smooth, black finish for easy carrying in the coat pocket, and obviously intended for the advanced amateur who seeks the largest possible efficiency and serviceability in his cameras.

Like most modern hand cameras the Kern "Bijou" is attractive to the eye, extremely compact and light in weight, despite its remarkably sturdy construction. It differs from many instruments of its kind, however, in several outstanding features which demand special attention, e.g. in its unique finding device, its unusual extension capacity (7 inches), swivel revolving back and the super-rigidity of the lens front and entire camera when extended in use.

The finder is quite novel in design and not easy to describe without illustration. It must be

seen. Briefly it is a small aperture in the upper corner of the camera back, on looking into which with one eye (while looking openly at the subject with the other (free) eye) you see a brilliantly lighted view of all of the subject that falls within the limits of the plate, superposed or projected on the full view of the subject as visible to the other (free) eye. The finder image is bounded by short black lines indicating the portion of the subject within the plate limits, and a small black cross determines the center of the picture.

The Camera is fitted with a Kern anastigmat, F:4.5, of 4¼ in. focal length, and a Compur shutter; a rack and pinion movement for fine focusing, and the lens front has a full rise of 1¾ in., with a fall of ½ in., thus providing for the correct spacing of the subject under a wide variety of conditions. The American agent for the camera is Burleigh Brooks, 36 Liberty St., New York.

Ansco Photoproducts, Inc., is the new firm name of the familiar Ansco Company, manufacturers of Ansco cameras and film, Cyko paper, etc., and indicates a complete reorganization and refinancing of the firm with a view to a large expansion of business in 1924. The Ansco Photoproducts, Inc., has plants at Binghamton, Johnson City and Afton, N. Y., and ample resources for extensive activities. Many prominent business men make up the personnel of the new directorate. Horace W. Davis, who took over the management of the old business in 1922, continues as President of the new organization; George W. Topliff is Vice-President and Treasurer; Clarence B. Stanbury will continue in charge of the British branch; and John S. Norton is the Secretary of the organization.

Books and Prints

All books mentioned in these pages may be obtained from the Publishers of The Photo-Miniature **and will be forwarded promptly, postpaid, to any address on receipt of the prices quoted.**

Photograms of the Year, 1923-24. Edited by F. J. Mortimer. 38 pages text, 88 illustrations. Paper covers, $2.50; cloth, $3.50. London: Iliffe. American Agents, American Photographic Publishing Co., Boston.

Looking through the richly illustrated pages of this new volume of "Photograms of the Year" I wonder, for the hundredth time, why American photographers (including all the 57 varieties) are so indifferent to this most interesting of photographic year-books. The edition printed by the English publishers is, I am informed, close on 15,000 copies, of which, after a quarter of a century's successful issue, these United States take less than 1500 copies.

As a profusely illustrated Review of the world's pictorial photographic work of the year, the 88 illustrations being selected from about a thousand prints submitted to the editor for his choice, "Photograms" is unique in suggestive value and material for study on the part of all serious workers in the pictorial field. The best pictures of the great exhibitions of the year are here carefully reproduced, with many beautiful works in landscape, genre, figure and group composition, marines, nudes, portraits and "characters" not seen in any exhibition.

It is, in fact, a remarkable exhibition of pictorial photographic work, crowded with interest for amateurs and professionals who seek inspiration and

encouragement in their work; clever poses of the figure and admirable examples of grouping; beautiful arrangements of the natural scene: mountains, streets, pastoral compositions and the sea; a few delightful interiors and too many nudes for my fancy. A wonderful book.

The text, as usual, gives reports of the progress of pictorial photography in many different countries, of which Mr. Tilney's review of "Pictorial Photography in 1923" is the most interesting, perhaps because of its direct reference to many of the pictures reproduced. The American reports are by Mr. Floyd Vail and Mr. Arthur F. Kales, neither of them mentioning the most significant photographic exhibition of the year as far as America is concerned—the second Stieglitz show at New York in April.

As the English publishers report "Photograms" as sold out "over there" and there were less than 1500 copies imported by the American agents, I suggest that those who are interested in seeing the book should apply to their dealer without delay.

Penrose's Annual: The Process Year Book and Review of the Graphic Arts. Vol. XXVI, 1924. Edited by Wm. Gamble. $4. London: Lund, Humphries. American Agents, The American Photographic Publishing Co., Boston.

Apart from the tendency to broaden its field to include such branches of book making as type composition and binding, this new volume of the old, familiar "Process Workers' Year Book" steadily maintains its leadership as the book of the year so far as the graphic arts are concerned.

There are 136 text pages and 67 illustrations, these latter comprising fine reproductions of paintings, bookbindings, posters, title pages, pages from notable books, book wrappers, periodical illustrations, typographical examples, catalogue work and commercial subjects. Among them are examples of

printing in 6, 5, 4, 3 and 2 colors by different methods, e.g. gravure intaglio, Rembrandt gravure, rotary gravure, offset and photo-lithography, with a few novelties in color and monochrome line work.

The text includes an interesting survey of "Process Work in 1923," by the Editor and thirty-four papers dealing with reproduction methods, photographic type composing machines, process screens, types, book jackets, private presses and similar subjects of interest to the student in graphic arts.

The Agfa Handbook, by Dr. M. Andresen, is the official formulary and guide to the use of Agfa plates, films, light filters, developers, auxiliaries and flashlight specialties. With the smaller Agfa Color Plate booklet, just issued, it gives a very useful summary of the Agfa products and their uses. Formulas, practical working methods and the chapters by Dr. Andresen on the elementary technique of photography, together with the abundant illustrations scattered through the text, make this Handbook a profitable guide to everyday practice in photography. It is obtainable from Agfa Products, Inc., 114 East 13th Street, New York, at the nominal price of fifty cents.

Fascinating San Francisco is a delightfully illustrated *brochure* of 64 pages, sent me by the Camera Craft Publishing Co., of that City and, presumably, intended to remind me of the pleasures of life in that wide-awake Pacific Coast town.

The Little Red Guide to home brewed wines is another alluring *brochure* from the Pacific Coast, published by my old friend F. Dundas Todd, 107 Hollywood Cres. Victoria B. C. Canada, at a dollar the copy. It contains receipts for making those fragrant wines of one's childhood—dandelion, elder-

berry, rhubarb, cowslip, parsnip, and sundry other delectable meads.

Modern Development; by F. Roy Fraprie. Methods and formulas; 79 pages. Paper, 50 cents; cloth, $1. A handy summary of the development processes used in negative making, the English factorial and American "Thermo" methods being fully dealt with.

Practical Printing Processes, by F. Roy Fraprie. Blueprints, self-toning papers, P.O.P. and D.O.P., platinum, carbon, gum-bichromate, bromide, kallitype, carbro, etc., 56 pages. Paper, 50 cents; cloth, $1.

These are the most recent additions to "The Practical Photography Series" issued by the American Photographic Publishing Co., Boston. Like the earlier issues in this Series they are very direct and practical in their information and give useful summaries of their subjects from the beginner's viewpoint.

Manual of Reproductive Illustrating for Photo-Engraving, by Lyn R. Schuler. 84 pages, profusely illustrated. 1923. Cloth, $3.

Originally written for distribution by photo-engravers among their customers, this handbook aims to describe and illustrate all the different kinds and styles of photoengraving in line, tint, stipple and halftone, in black and white and colors. It is well done and should prove most useful to those purchasing and using large quantities of blocks for illustration purposes.

A Survey of Professional Photography, as a field of employment for young people leaving school, is given by May Rogers Lane in Bulletin Series No. 2 of the White-Williams Foundation, Phila-

delphia. It is based upon research work among Philadelphia studios during 1923 and contains much curious information.

Dr. J. M. Eder sends from Vienna the good news that he is working on the "Jahrbuch fur Photographie" 1923-24. No date of publication is announced, but the book will be published by the firm of Wilhelm Knapp, Halle a/s, Germany, to whom orders should be addressed.

"The Future of the Cinema Projector; and Photography as an Extension of Vision" was the subject of the twenty-sixth Traill-Taylor Memorial Lecture, given by H. Dennis Taylor, before the Royal Photographic Society in January. A complete report, covering 28 pages, is published in *The Photographic Journal,* February, 1924. Price, 2/6 (60 cents), from the Secretary of the R.P.S., 35 Russell Square, London, W.C. 1. In the same issue of the *Journal* there is an interesting paper on "Kinematography and its Antecedents" by Will Day, chairman of the new Cinema Group formed within the Society; an abstruse communication on "The Sensitivity of the Silver Halide Grains of a Photographic Emulsion," by Walter Clark; an account of the "Motion Picture Densitometer" devised by J. G. Capstaff and N. B. Green, of the Kodak Research Laboratory, Rochester, and illustrated papers on "Architecture in Relation to Pictorial Photography —a Rejoinder," and "Pictorial London." A noteworthy issue of the *Journal,* now in its sixty-fourth volume!

The February issue of "The Professional Photographer" (the English equivalent of our "Studio Light" and published by Kodak Ltd., London), is illustrated with four reproductions in color from

multi-color bromoils by Walden Hammond, of Leamington Spa. The two portraits given are somewhat heavy in color and less pleasing than the two outdoor scenes reproduced, but the pictures are interesting as showing that European professionals are using the bromoil method in a business way.

Abridged Scientific Publications from the Research Laboratory of the Eastman Kodak Company. Volume VI. 1922. 238+VII pages.

Students of the physics and chemistry of photography will welcome this handy volume, containing abridgements of the scientific communications issued by the Kodak Research Laboratory in 1922 (Nos. 132 to 166, Nos. 144, 155 and 162—164 being omitted). These have already been published *in extenso* in various journals, to which the reader is referred for details not given in the abridgements. Many of the papers are extremely technical, but here and there may be found information of practical usefulness to the photographer, as in communication No. 135 on "The Use of Artificial Illuminants in Motion Picture Studios," by L. A. Jones. Authors' and Subject indices are provided and it is announced that the *Abridgements* will hereafter be published annually.